PUBLIC WORKS

CITY COUNTY STATE

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A Notable Series of Articles

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The WATER WHEEL—Economics of Maintenance and Reconstruction—Brick Pavements on Flexible Bases—Public Appreciation of Efficient Engineering Work.

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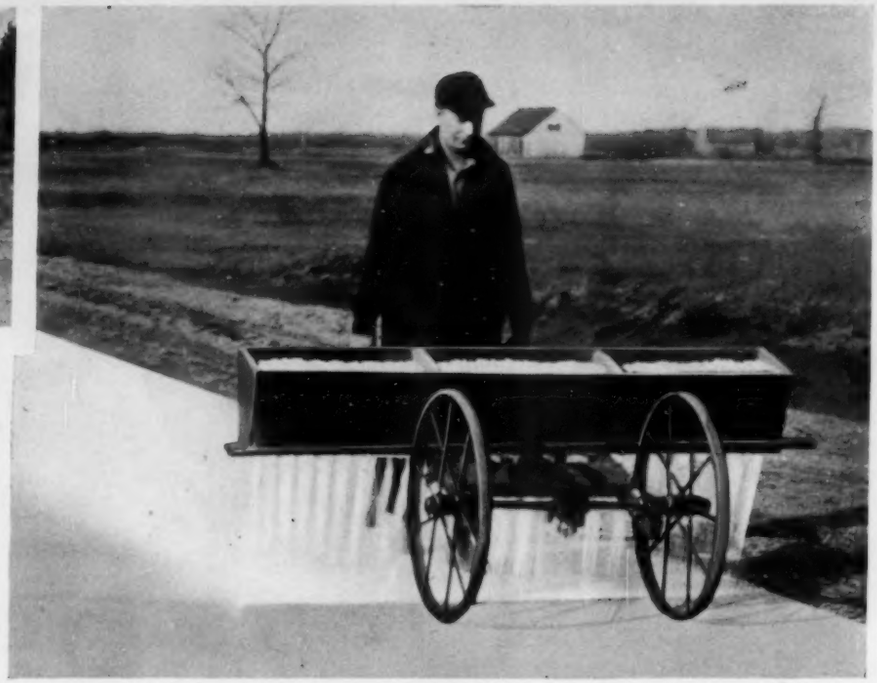
W. A. HARDENBERGH BENJAMIN EISNER

APR 13 1933

APRIL, 1933



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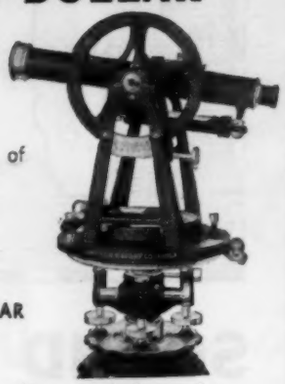

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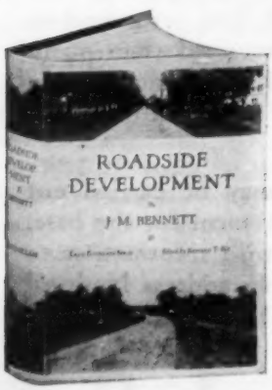

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On page 51 you will find a special service department for readers of PUBLIC WORKS who want literature covering the very latest developments in equipment and materials used in the construction of public improvements.

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City County State

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? ? ? Brainteasers ? ? ?

It is heartening to contemplate the amount and variety of comment generated out of the problems that have appeared here. There must be truth in stories of postmen who find relaxation or amusement in a hike, for here we have a large circle of friends who, by profession, must solve many mechanical problems, turning to the same sort of thing for fun or diversion. A recent survey showed 14% of our readers, or about 1400 of them, interested in "Brainteasers."

Little Drops of Water:

A foundation contractor is making an excavation in sand. Ground water rises in the pit. He finds that two small pumps will dewater the excavation from a standing start in six hours, and that four such pumps will do the job in two hours. How many pumps must he use to do the job in 30 minutes?

Also Little—But Oh My:

What five different numbers add up to less than 250, so that each of the numbers is divisible into the sum without remainder, and for which sum there are no other factors, except, of course, the sum itself?

Last Month's Teasers:

The formula for the number of commissions due in the sales problem is found by adding formulae for the sums due on each chain of sales. Each of these sums is the total of a geometric series whose first term is unity and whose ratio of increase is "n." The first chain has "x" terms, the next chain "x — 1" terms, the next "x — 2" terms, etc.

Total for chain 1:

$$\frac{n^x-1}{n-1} = n^{x-1}\left(\frac{n}{n-1}\right) - \frac{1}{n-1}$$

Total for chain 2:

$$\frac{n^{x-1}-1}{n-1} = n^{x-2}\left(\frac{n}{n-1}\right) - \frac{1}{n-1}$$

Total for chain x—1:

$$\frac{n^2-1}{n-1} = n\left(\frac{n}{n-1}\right) - \frac{1}{n-1}$$

Total for chain x:

$$\frac{n-1}{n-1} = 1\left(\frac{n}{n-1}\right) - \frac{1}{n-1}$$

Adding the right hand members gives the required expression for the total of all commissions due, as follows:

$$\frac{n(n^x-1)-x(n-1)}{(n-1)^2}$$

The office manager won the April Fool Foot Race, since *his* steps were 3 feet long, so that he had to run beyond the pole to turn. When the racers were on their home lap *he* had lost twice 2/3 of a step or 4 feet, which is the distance by which *she* was leading all the way back. Yes, the office manager did win, and this lets the cat out of the bag, because that's who "she" was.

BENJAMIN EISNER.

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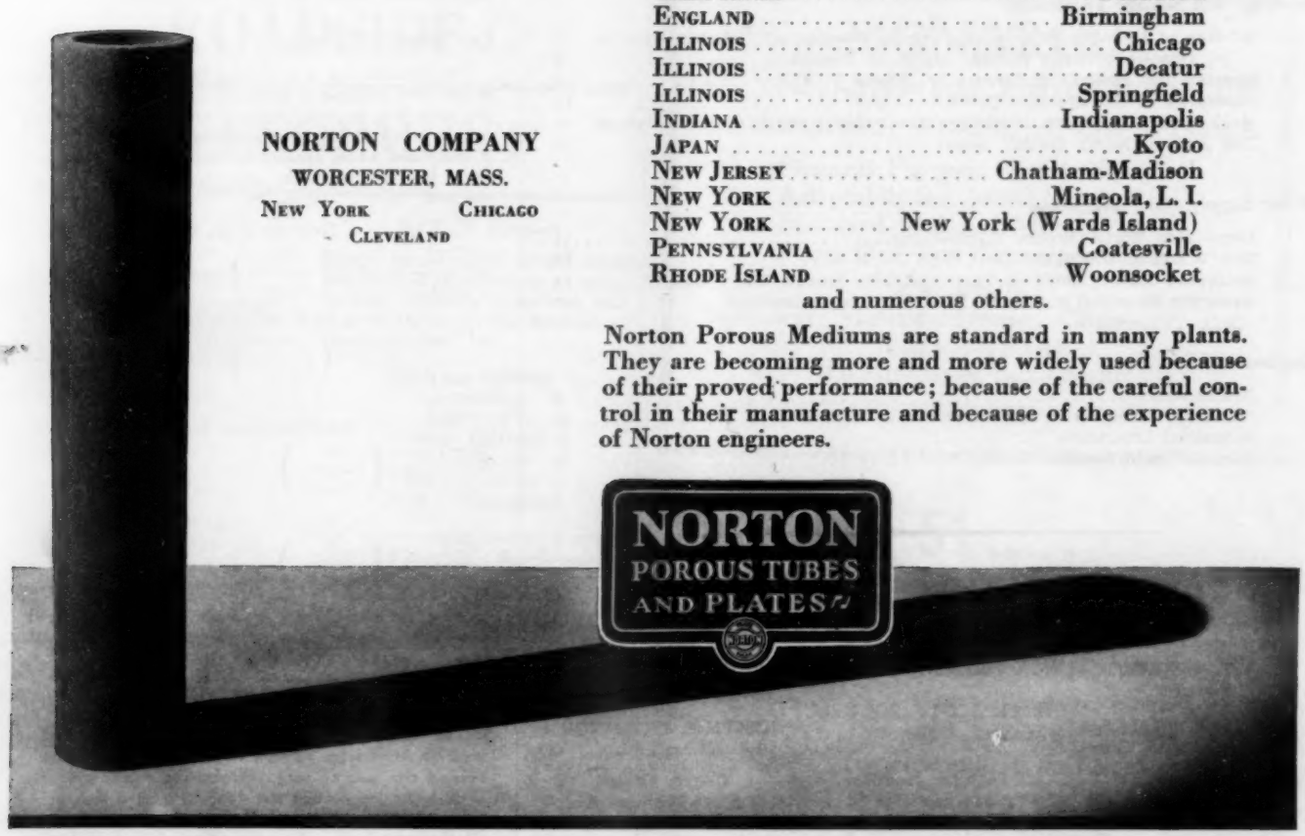

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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 64 — *April, 1933* — No. 4

How to Get Public Appreciation of Efficient Engineering Work

THIS question was asked us recently by the city engineer of a smaller city, and in slightly different forms has come before the Editor many, many times. Upon its solution depends, to a great extent, the successful carrying out of many of the engineer's projects for improvements in public works and service, for only in so far as he has the confidence of the community will he be permitted to develop these plans.

One who prefers to remain unknown offers the follow suggestions as a reply to this question:

The general answer is—must be—publicity. Before condemning too freely the various types of publicity to be mentioned hereafter, let the engineer consider himself and his position, and the responsibilities attached thereto. He is a public servant, paid by the public, and because of his special knowledge it is his duty to guide and *lead* the responsible city officials. If he isn't a leader, if he hasn't the prestige and the confidence of the city adminstration and the city taxpayers, he surely falls far short of possessing full qualifications for the office, and he can not secure the accomplishment of things that his sound judgment tells him the city needs. Perhaps parks, or schools or health or other quite worthy departments are getting the money that he knows full well is more urgently needed for a better water supply, for proper refuse disposal, for adequate streets. If that is the case, what can be said except that he doesn't possess the necessary confidence and appreciation of the taxpayers, and is failing in his sworn duty to them?

There are at least eight ways available to the average city engineer by which he can sell himself to the taxpaying public and none of these is incompatible with his dignity or violates professional ethics. As a matter of fact, some, or all, of them are necessary to any engineer who wishes to progress in his chosen profession. These eight ways fall rather roughly into two general groups, of which we may call one impersonal and the other personal.

The Impersonal Group

Local newspapers are published in probably every city large enough to afford a city engineer. Such papers form perhaps the best means of reaching the public and of giving it an insight into what the engineer's office is doing. The city hall reporter is usually a blase and tired young man, but he is looking for news, and if the city engineer can give it to him, well and good.

The power of the press is marvelous. One case comes to mind where a technical official of a city who had been rather unpopular was, within two years' time, selected as its most valuable citizen of that year. The greatest single factor in this particular case was the rather doglike devotion to this man of the city hall reporter of one of the local newspapers. In this case, the technical official was of outstanding ability, but not a good mixer and utterly unable to sell himself to the public.

Remember that the reporter is a man with a job to do. The doings of your office should be public property; make available to him whatever material you have. Don't patronize; don't ask for publicity. Simply tell him what the department (not yourself) is doing for the city. Give interesting details. Be patient. Work with him. You can be sure, in advance, that many of the technical data he gets will be sadly garbled, at first, but most of the misinformation will be unimportant, so don't let it worry you. Gradually, he will get a grasp of what you are doing, and the errors will become fewer. As a matter of fact, he probably won't make as many errors in quoting technical details as you would in trying to write a newspaper article.

Once in a while, when some interesting work is at a stage where it may attract public attention, call up the editor of the newspaper and offer to provide facilities for taking pictures of the work. In such cases it is safer to have a simple description of the work written in advance and to pass this out to the reporter, than to let him try to gather the information on the job. Have some one familiar with the work accompany him to answer questions, however, and don't select a man who is too technical or too naturally pessimistic.

The above represents but a fraction of ways and means available for obtaining decent and reasonable newspaper publicity. As acquaintance with the reporter and the newspaper progresses, the engineer is likely to find not only that newspaper men are quite ordinary and human citizens, but also that there are many other ways of cooperating with them in a sane and dignified manner to obtain necessary publicity of the work the department is doing. Don't play favorites. What you tell one reporter, tell all. Be fair, open and reasonable.

Window Displays. In most cities, window displays of photographs, cartoons, models, etc. giving information concerning municipal matters will, if placed in the most frequented retail business district, reach more people and put their messages across better than can newspaper articles. They can not, however, take the place of the latter in explaining policies or giving any-

thing but the bare facts relative to municipal matters of any kind.

Space for such a display, which need not be large, can generally be obtained from a merchant through his interest in civic matters, the attention it will draw to his store, or other considerations. All letters or figures in the display should be large enough to be read easily 20 feet away, and convey strikingly information that is easily comprehended.

Such information may be present cost of some public service compared to cost of improved service plus annual cost of the improvement. Or a diagram of proposed street widening. Or a map showing long haul to a dump and short haul to a proposed incinerator, with saving in cost of haul.

Models are especially useful in explaining the construction details and operation of water purification or sewage treatment plants, park developments or other physical structures. They generally will attract more attention than any other publicity medium but are also more difficult to prepare.

Annual reports are a neglected form of publicity, the importance of which is too often unappreciated. Of seven of them lying on my desk, only one gives even a shred of real information that could be of the remotest interest to anyone but a practically defunct statistician. And the one that does give a little reluctant information is dated—"For the year ending June 30, 1931." It came to this office 17 months later.

Three requisites: Promptness,—it should be out within a month; Interest: a report that the taxpayers can understand and read without acute somnolence; and an attractive form. The first requirement may be obtained by mimeographing an abbreviated and snappily gotten up report, if this is necessary because of delay in issuing the complete city report due to treasurer's reports or other reasons; perhaps, the second, by getting advice and assistance from the above-mentioned newspaper reporters. The third is just good common sense. For each of the last two, try to realize just what would appeal to the average non-technical taxpayer who wants to know where his tax money goes.

Technical articles are a mighty help in fixing the engineer's standing with engineers from other communities. And don't try to dash off an article in one attempt. Most good technical writers rewrite each article from three to five times or more. Supply photographs or drawings to accompany it. Most engineering magazines formerly paid sparingly for such articles, and some still do, but the return is never commensurate with the work. So don't expect it. And don't send the same article to three or four magazines, unless you say so plainly, and then don't expect any pay for it. And do not overlook the fact that frequently local papers will republish such articles, if an opportunity is given them.

Membership in one or more high-class engineering societies is most desirable, and occasional opportunity is offered to present papers at meetings.

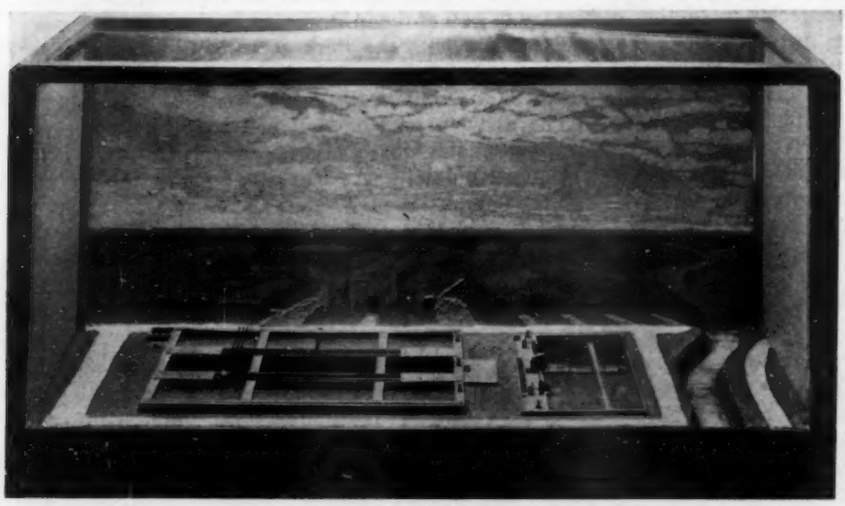
The Personal Group

The *personal impression* the engineer makes on the taxpayers and citizens he meets, and the judgment they form of his knowledge, ability, leadership and good sense, very often determine largely his standing in the community. Also, belong to one or more local clubs and, when the opportunity offers, go before them and also before the Chamber of Commerce and civic organizations and tell something of the work of your department. Encourage your assistants to do the same.

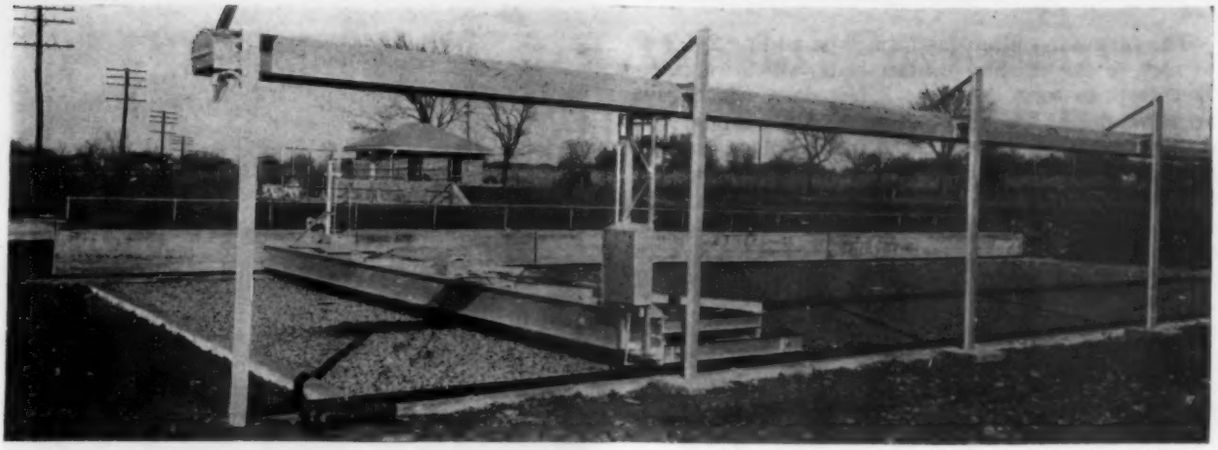
When *talking*, don't read a pre-written speech. Speak clearly and loudly enough for all in the room to hear. Don't reel off a lot of figures; make it understandable to the below-average hearer, and short and snappy, not long-drawn out and monotonous. If you can't talk, try to learn how. If you can't learn, pick out one of your assistants who can talk, and hand these assignments over to him. If you are the right kind of boss and leader, he'll want to say some nice things about you that you wouldn't dare say about yourself, which is one advantage over doing the talking yourself.

In making *office contacts*, courtesy, promptness and the other requisites that go with them make a big hit with the taxpayers that come to see you. And the office ought to be neat, clean and precise as an engineering drawing, and this is easily possible even though your quarters and furniture are nothing to brag about. Books, maps and data ought to be filed—or at least kept reasonably out of sight—and not left in great dusty piles.

The *quality of your assistants* and their morale are highly important factors. The methods of attaining these qualities take us into the realm of that most interesting field of leadership. But that is an article in itself, or several articles, and here we can do no more than to state one or two basic principles of leadership. Don't do anything yourself that one of your assistants can do. In doing it he will grow in ability and in confidence and pride in himself and his knowledge, and will respect and follow you. And, in assigning him a task, give him the greatest possible freedom in accomplishing the work, requiring only that the results attained be such as will fit into the general requirements of the whole project.



Model, with oil painting background, showing details of sewage treatment plant. This was prepared by Link-Belt Co. for its exhibit at the Century of Progress Exposition.



Traveling trough distributor on trickling filter

Salvage of Existing Structures Permits Economical Rehabilitation of Obsolete Sewage Works

By F. M. Veatch

Black & Veatch, Consulting Engineers, Kansas City, Missouri.

THE reconstruction of the 20-year old septic tank-contact filter plant at Osage City, Kansas, which cost approximately $24,000, was a relatively small sewage disposal project, but is of general interest since the utilization of structurally sound but obsolete existing structures resulted in construction costs nearly 25% less than that of new works and involved no sacrifice in the matters of appearance and utility. In view of the present financial conditions, the saving made possible by this procedure is well worthy of attention.

The past history of this plant, built in 1912 to serve a city of approximately 2000, is typical of many installations made in accordance with the then current recognized standard practice, but which have become obsolete due to advances in the art and more rigid requirements in the matter of results. Judged by present-day standards, this plant was never satisfactory, although its effluent was probably comparable to that from the average plant of this type. At any rate, the plant was tolerated for years simply because it was in existence and in spite of the fact that it did not accomplish the purpose for which it was built, i.e. the abatement of nuisance in the receiving stream. This toleration also will be recognized as typical.

The original plant consisted of a three-compartment septic tank and four contact beds. The lack of provision for sludge removal and drying in the original layout was met with a diaphragm pump and an improvised lagoon, which, due to the character of the sludge handled, constituted a very considerable nuisance.

On examining the plant previous to the design of improvements, it was found that the concrete in the septic tank was sound below the water line, although that in the roof and exposed walls was badly disintegrated. The concrete walls and floors of the contact beds were in excellent condition, and the ballast of crushed limestone, while badly clogged with sludge, needed no more than washing to make it usable.

The plan of treatment selected after a study of the local conditions included coarse screening, pre-aeration, settling with separate sludge digestion, sprinkling filter treatment and final settling. Since comparative estimates showed that a new plant would cost $31,000, while a similar plant utilizing the existing structures could be built at a cost of $24,000 the latter plan was adopted.

The screen chamber and pre-aeration tank are, of course, entirely new and consist of a hand-cleaned rack with 1-inch clear openings and a tank designed to permit a 10-minute contact with diffused air applied through a grid of Norton porous tubes.

The settling tank and sludge digester were formed by fitting one of the compartments of the original septic tank with apparatus for sludge and scum removal, and placing a new cover fitted with gas collection domes over the other two. A new coping was placed on the wall of the compartment used for settling, and since this connects with the digestion tank cover, none of the old concrete is visible.

Revamped in this manner, the settling tank has an average detention period of approximately six hours, and the sludge digestion tanks have a capacity of 3.7 cubic feet per capita. Due to the fact that the digestion tanks abut the settling tanks and are well insulated with earth fill, the temperature conditions are similar to those in an Imhoff tank and no heating equipment was installed. Gas will be collected and used for the incineration of screenings and any excess will be wasted.

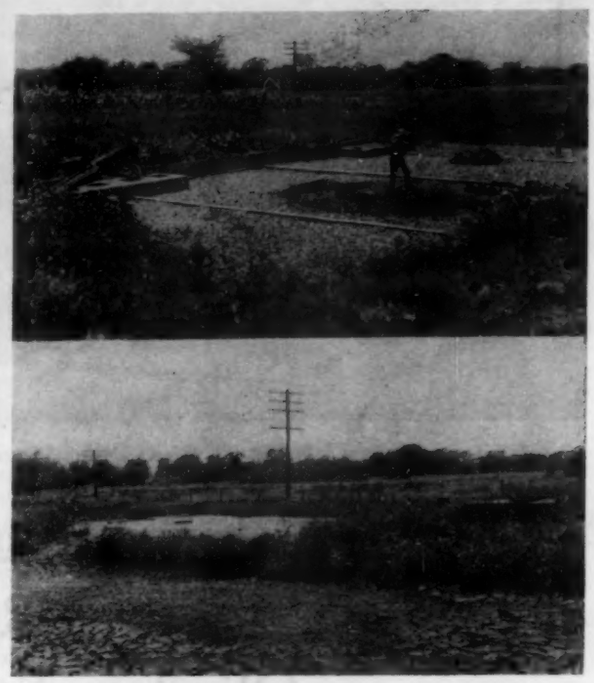
The sprinkling filter was formed by adding 2½ feet of rock to the existing contact beds, which were 4½ feet deep, to form one filter 7 feet deep, which gave an allowance of 15 cubic feet of stone per capita. The original contact beds were dosed from a siphon chamber and a total head of approximately 9 feet was available for the sprinkling filter. This was obviously inadequate for the conventional dosage by sprays, but ample to accommodate a travelling distributor of the type once quite widely used in England, but rather rare in this country.

The plan adopted was to conduct the settled effluent to a narrow channel along one side of the sprinkling filter and to siphon it from this channel to a distributing trough suspended in a motor driven carriage, which spans the bed. The original scheme of driving by power derived from the falling sewage, as used in the original (Fiddian) distributors, was discarded in favor of a motor drive, since the latter is standard equipment in the manufacture of crane equipment and the apparatus used is simply a travelling crane, which carries a distributing trough. A small vacuum pump located on the distributor and driven by a small independent motor insures continuous operation of the siphon. The settled sewage is discharged from the distributing trough through small triangular notches, and a small semicircular splash plate is welded on the outside of the trough beneath each notch to insure even dosage. As in the case of the settling tank, all old concrete was covered by new work and, as far as appearance is concerned, the plant is new.

A final settling or humus tank has been provided, and is equipped with a small motor-driven sludge pump operated through an automatic time-switch to permit regular and frequent removal of sludge. This tank has an average detention period of approximately 1½ hours.

Sludge drying beds of conventional design and with an allowance of 1 square foot per capita, have also been provided.

While the new plant has not been in operation long enough to show representative results, its behavior to date has been very satisfactory and there is every reason to believe that it will serve the purpose for which it was designed fully as well as an entirely new plant.

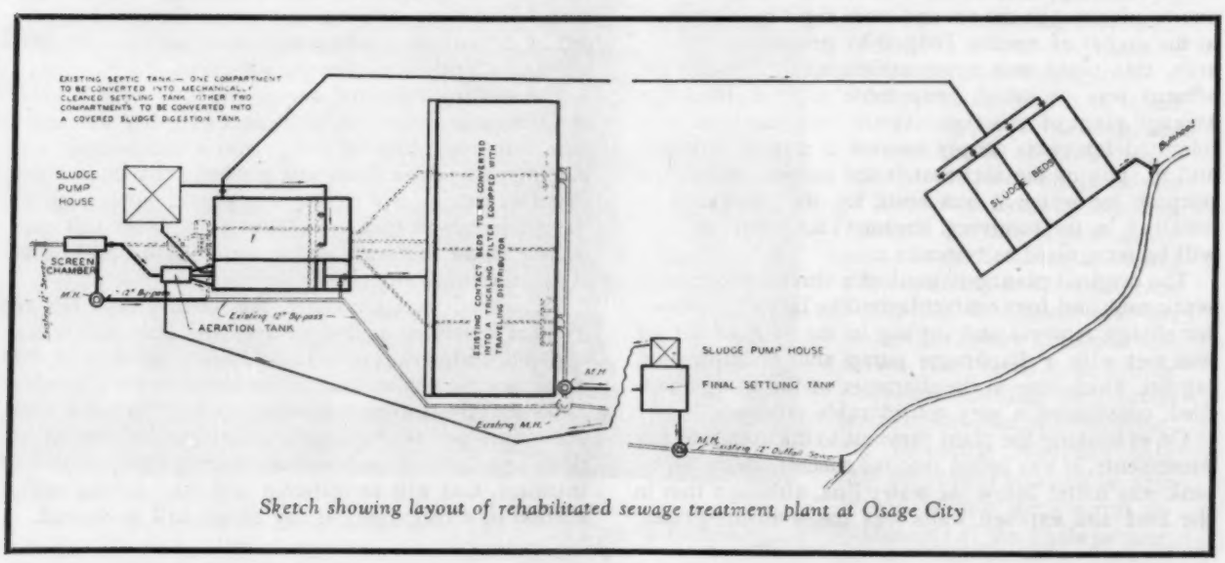


Above—Contact beds previous to conversion into percolating filters. Below—Septic tank at rear, sludge lagoon in foreground

Construction was begun in September, 1932, by the Walters Construction Company of Manhattan, Kansas, and the plant was put into operation February 1st, 1933.

The mechanical equipment for the settling tank and sprinkling filter was furnished by the Link-Belt Company, and a great deal of credit is due to the engineers of this company for ingenuity in the adaptation of standard equipment to the particular requirement of this project.

The plans and specifications were prepared by Black & Veatch, consulting engineers, Kansas City, Missouri, and the construction work was done under their supervision.


EXISTING SEPTIC TANK — ONE COMPARTMENT TO BE CONVERTED INTO MECHANICALLY CLEANED SETTLING TANK. OTHER TWO COMPARTMENTS TO BE CONVERTED INTO A COVERED SLUDGE DIGESTION TANK.
SLUDGE PUMP HOUSE
SCREEN CHAMBER
AERATION TANK
EXISTING CONTACT BEDS TO BE CONVERTED INTO A TRICKLING FILTER EQUIPPED WITH TRAVELING DISTRIBUTOR
SLUDGE PUMP HOUSE
FINAL SETTLING TANK
SLUDGE BEDS

Sketch showing layout of rehabilitated sewage treatment plant at Osage City

Depression Water Works Engineering At Liberty

HEAVY expenditures for a new source of supply faced the village of Liberty, N. Y., in 1931, unless the system then furnishing water could be renovated and improved.

The main source of supply is Lilly Pond, from which water is carried through an 8-inch line about 8 miles long to high and low pressure reservoirs near the village. Revonah Lake, about 3 miles north of the village, which was the original source of supply, now is used as a secondary supply. The Lilly Pond supply is gravity, while the Revonah supply must be pumped.

The Lilly Pond supply was constructed some ten years ago when the original supply became insufficient for the needs of this important summer resort village. Though the winter population does not exceed about 4,000, the summer visitors add about 7,000 during the three summer months. The nearby communities of Ferndale and Swan Lake also draw from the Liberty supply.

By 1931, the gravity system could no longer supply enough water for the summer demands, and the old pumps of the Revonah supply were replaced and used for the summer months. Even with this reinforcement, the heavy draft on holidays and week-ends brought the supply dangerously low.

In the fall of that year, the Board of Water Commissioners engaged an engineer to advise on the problem. His preliminary study showed that the 8-inch line was not delivering as much water as it should, and that some leaks undoubtedly existed. Much of this line had been laid by force account and no records existed in regard to it. Therefore a careful survey of the line was made, in the course of which valves and appurtenances were located and recorded, and elevations taken on the pipe line at frequent intervals. This was done primarily to locate summits in the line which might serve as air locks. At the same time a thorough study of consumption was made by checking all meter readings in the clerk's office for the preceding twelve months. This was necessary because no other means existed for recording consumption or, for that matter, the flow.

These surveys and studies disclosed the fact that there was either gross leakage in the line or obstructions in it which prevented it from delivering its maximum theoretical flow, which was estimated at 875,000 gallons per day. For August, 1931, average daily consumption for Liberty and the neighboring villages supplied by it amounted to only 623,400 gallons, as metered, yet a contribution from Revonah Lake estimated at 375,000 gallons per day barely permitted keeping pace with the summer months consumption.

The survey showed a number of high points on the 8-inch line at which no air relief valves had been installed and where air pockets might restrict the flow.

The first step toward definitely locating and eliminating troubles was the purchase of a Simplex Valve and Meter Co. pitot tube apparatus. The water superintendent was sent to the factory for instructions in its use, and on his return the 8-inch line was tapped initially at two critical points, the tube inserted, and a 24-hour test run. These showed that the line was actually delivering about 720,000 gallons per day to the village, and that the leakage in the 8 miles of line was relatively small. Continued work at various points in the village with the pitot tube showed that between the point tested near the village and the high-pressure reservoir, and in the distribution system of the village, there were leaks totalling about 220,000 gallons per day. These were located and eliminated; and later, other less important leaks were found and remedied.

As time permitted, air relief valves were installed at the more important points in the 8-inch line, and the intake at the lake was improved. In December, 1932, pitot tube measurements showed that 878,000 gallons per day were being delivered into the high-pressure reservoir. So much improvement had been effected before the beginning of the 1932 summer season that the Revonah pumps were operated only occasionally, and it is probable that their use could have been dispensed with entirely, if it had been necessary.

Other Improvements

There had been some complaints from tastes, probably principally due to algae, which were present in both lakes. Early in 1932 these were treated with copper sulphate, and this treatment was continued as needed throughout the summer. This practically eliminated complaints from this source, but as an additional safeguard, the water is now being treated with ammonia as well as chlorine.

New lines have been laid to give better pressures throughout the village and to provide a more satisfactory pressure to Swan Lake. During the past winter, the Board of Water Commissioners have been able to make a material contribution to unemployment relief through the construction of a number of new mains and replacing of small mains with larger ones.

Cost of the Work

The costs of the work are of particular interest. They were approximately:

Pipe line survey and engineering fees	$1,250
Apparatus for measuring flow	200
Air relief valves and their installation	250
Incidentals	250
	$1,950

As a result of this expenditure, an ample supply is available, so that pumping probably will not be needed hereafter. A greater amount of water is being sold to neighboring communities, with an increased revenue to the village, and because of the better pressure these communities are better satisfied and have given up plans for developing supplies of their own. Pumping costs, which in two years would have almost equalled the total amount spent, have been eliminated.

The Water Commissioners of the village, who have been largely responsible for this forward-looking program, are M. C. Heidt, chairman, A. Doeinck and Leon Killian. The superintendent, who has had field charge of all the work, is Charles Heidt.

Brick Pavements on Flexible Bases

By John H. Lowe,
County Engineer, Dougherty County, Georgia

FOR many years I have been making a study of local materials and their uses in connection with road building. My county, like many other counties in Georgia, has excellent road building materials available at a cost a little greater than the expense of hauling. Our clays are usually good and the sand deposits are in many cases coarse enough for sand-clay mixtures. With these cheap materials at hand, and having been convinced that a sand-clay base would prove entirely satisfactory for a brick surface, I recommended this type of construction on five miles of paving an old road. It seemed best not to close the road to traffic, which would involve a long detour.

The road had been regraded about a year before the paving was begun. In grading, all fills were made in layers not over eighteen inches in depth and all material was hauled in trucks over the freshly placed material. This gave us the benefit of compaction by our truck haul as well as by the usual traffic on the road. The top two feet of all fills were made of selected materials, when necessary; and in all cuts where doubtful material was encountered this was removed to a depth of eighteen inches and replaced by selected material. All necessary drainage was placed and the finished grade of the road throughout was well above water line at all low places.

The brick surface was placed on a sand-clay base, eighteen feet wide between 5x12 headers. The brick were 2½-inch vertical fibre, vitrified brick, laid on a 6-inch (when compacted) sand-clay base which had received a tar prime before a ¾-inch sand cushion had been placed. An asphalt having a penetration of from thirty to forty was used for a filler.

Before starting the base, numerous tests were made of both the clay and sand borrow pits; also many experiments were made with different mixtures of different proportions of sand and clay, with the result that we finally settled on a mixture containing not less than ten and not more than thirteen per cent of clay.

The materials from the different borrow pits were placed on the road and measured by means of side boards and templates, striking each material off at the proper depth to get the proportions desired. The sand was placed at the bottom. The materials were then mixed by plowing and harrowing until tests of the mixture showed the desired uniformity. In most cases the materials from the borrow pit contained sufficient moisture, but, where necessary, water from a road sprinkler was added. The road was then brought to a true surface with a road machine or a motor patrol and left open to traffic.

We found that after the material had partly set and the surface dried out, no machining could be done except immediately after a rain or after the whole surface had been thoroughly wetted by sprinkling. This precaution is necessary to prevent "scabbing," that is the formation of thin laminations on the surface of the road.

After the base had been completed and set up under traffic, the concrete headers were built to hold the brick at the outer edges of the road. These headers were built by using 3x6-inch dressed plank, set five inches apart, and spiked to the base with 12-inch round spikes. The planks were drilled for the spikes at about eight foot spacing. These planks were used over and over, being removed as soon as the concrete had set up.

After the 3x6 plank had been trued up to the correct height, the material between them was removed with special spades to a depth of twelve inches below the top of the plank. The concrete was then poured, leaving contraction joints every ten feet and expansion joints every one hundred feet.

After the headers had been completed, the surface of the road was trued up to the proper depth and approximate crown of the finished surface of the brick, then the tar prime was applied in the usual manner and, when time had been given for it to penetrate, the sand cushion was placed. The sand used in the cushion contained about five per cent of clay. This was brought to a true surface, about one inch thick, by means of a template of the same crown as the finished road and then rolled with a light hand roller. It was then again brought to a true surface with the template, trueing it off to three-quarters of an inch in thickness. On this sand-clay the brick were laid in the usual manner. After the brick were culled, the surface was rolled with a three-ton roller until it was true, with no variation of more than ¼ inch in ten feet. All spaces between brick were then immediately filled with asphalt and the surface covered lightly with sand.

Among the advantages of such a flexible-base pavement are: Ease and cheapness of repairs; rapidity of repairs; low original cost; resistance to frost action; and a resilient riding surface.

The above article is an abstract of a paper before the Annual Convention of the National Paving Brick Association.

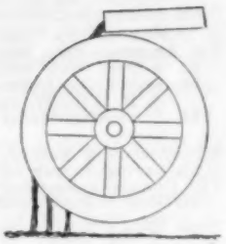
Retained Percentages Under Paving Contract Taxable Only When Paid

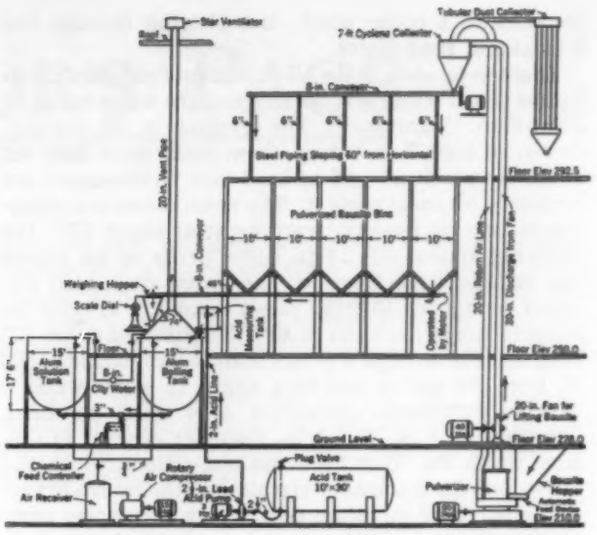
Where a paving contractor during the four years from 1924 to 1927 completed pavement construction contracts under which substantial portions of the agreed consideration were retained by the municipalities for which the work was done, to guarantee maintenance of the pavements for specified periods, the Circuit Court of Appeals, Sixth Circuit, Commissioner of Internal Revenue v. Cleveland Trinidad Paving Co., 62 F. (2d.) 85, holds that the Board of Tax Appeals was right in holding, as contended by the paving company, that the retained percentages were taxable as income, not for the years in which the contracts were completed, but for those years in which the money, or the residue, was paid to the contractor.

It was not disputed that the amount of the retained percentages might be materially reduced in the event of necessary repairs or the subsequent disclosure of a failure to comply with the specifications. Until the expiration of the period of guaranty the obligations of the several municipalities remained only a contingent promise to pay. Therefore the retained percentages were not to be considered income until they were in fact received, or until they became unconditionally payable.

THE WATER WHEEL

FOLLOWING are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.





Courtesy "Civil Engineering"

Diagrammatic Sectional Elevation Through Liquid Alum Plant Montebello Filters, Baltimore, Md.

DEEP TUNNELS for trunk mains instead of pipes have several advantages in large cities where the streets are filled with public utility conduits, rapid transit lines and other structures, in the opinion of Walter E. Spear,[1] department engineer of New York City B'd of Water Supply. It was estimated that it would require thirty 48 in. c. i. pipe to give the capacity of tunnel No. 1 of New York City. "Deep delivery tunnels are required only by our larger cities, where great volumes of water must be delivered through congested districts, the streets of which are already occupied by, or must be reserved for, rapid transit subways, sewers, pipes and ducts. Pressure tunnels in rock are cheaper than pipe lines of equivalent capacity" (under the above conditions) "and are less liable to damage and interruption from other construction or from earthquakes."

Coagulation costs exceed all other operating costs in many plants. In Richmond, Va., "improved coagulation has saved enough during the past year to pay all salaries, wages and operating expenses other than power and chemicals; and, in addition, the effluent has been greatly improved."[14] Here mechanical treatment of the water after application of the coagulant was found to be very important, the ideal treatment consisting of immediate and thorough mixing; keeping the floc in suspension a sufficient time, during which it "must effectively, and under control as to violence, sweep throughout the mass of water; and a proper return of a part of the settled floc and turbidity," found to be from 0.25 to 0.5 grain per gallon at Richmond. Alum was the coagulant used here.

Alum is by far the most commonly used coagulant in filtration, but the use of ferric compounds is increasing as it is better understood and they become more available. Several cities make their own alum from bauxite and sulphuric acid. At the Montebello filters in Baltimore a modern alum manufacturing plant has been built to make alum and utilize it in dilute solution and feed it automatically.[2] Liquid alum equivalent to 2,000 tons of lump alum a year is made at a cost of $13.59 a ton, besides a saving of $1.97 in the labor that would be required to handle lump alum.

Ferric coagulants are used in four forms—ferrous sulfate, ferric chloride, chlorinated copperas, and ferric sulphate.[8] The first can be used only for waters whose alkalinity will not interfere with color removal. Between pH 6.5 and 8.5 ferric floc forms slowly or not at all; in and beyond this zone, sodium and calcium ions in the natural water are most effective in coagulation. Ferric floc is more insoluble at both lower and higher pH values than is alum floc and the range of its use is therefore decidedly broader; and, as ordinarily formed, it has a higher specific gravity than alum floc. At Lawrence, Kans., ferrous sulphate resulted in better floc with less dosage than aluminum sulphate.

Softening plants have been built in over 100 municipalities during the past decade; 41 in Ohio alone, of which 34 are lime or lime-soda ash plants and 7 are zeolite plants.[5] Six of the zeolite plants were built during the last four years. The zeolites used recently are greensand (found in New Jersey) and the latest are gel types. About 30 municipal softening plants use zeolite. For making a choice between lime and zeolite, Applebaum lists 9 advantages for the latter and 3 for the former; but Behrman considers it more nearly a 50-50 proposition with the odds in the majority of cases in favor of lime treatment. Intelligent choice requires the following information: Is a place available for disposal of lime sludge? Is the water sometimes muddy? Is it safe bacterially? Is it excessively hard, and how much of the hardness is carbonate and how much non-carbonate, and how much is magnesium? Does it contain silica, high free CO_2, iron, manganese or hydrogen sulfide? What is the cost of salt, lime and soda ash? Is the supply of water abundant?

In using the lime system, tile removal of sludge is advocated by Schinman[48] as saving in construction and operating costs; reducing stream pollution, preventing sludge decomposition, and giving flexibility in design and operation.

Estimates for a 1.5 m.g.d. plant for Western Springs, Ill., gave the cost of a combined lime-zeolite plant as $22,350 as compared to $21,090 for a lime-soda plant.[45] The latter was adopted, including aer-o-mix aerating; rapid mix 5 minutes and slow mix 35 minutes, using Omega dry-feed machines and Dorr Co. agitator and clarifier; 2 hr. 20 min. settling; part of sludge returned to rapid mix tank; 24 min. carbonating with CO_2 from

the stack of a boiler plant; and filtering through two 0.75 m.g.d. sand filters.

Low temperature is the all-important condition affecting the construction and operation of the water works of Flin Flon, Manitoba.[37] The ground is all muskeg, frozen at least 7 feet deep (how much more does not affect the problem) and so hard that jackhammers are necessary for excavating it. The water comes to a pumping station by gravity, reaching it at about 32°. The pumping station sits 14 ft. below grade so the pumps can be kept from freezing, and steam from a 50 h.p. boiler is injected into the pump discharge to raise the temperature of the water to 38°. Distribution to the 300 residences is through a 6-inch main which extends 1800 ft. from the station and back again, in which water is kept in continuous circulation at 4 miles per hour. Branches of 4 in. and 3 in. diameter connect to this, from which are taken the house connections, which also are looped for continuous circulation, the return branch connected to a 2 in. return pipe, with a circulating pump at the pump house maintaining circulation in this smaller system. All pipes (and the sewer) are enclosed in one large cedar box; packed with sawdust and laid above ground for 13,000 of the 16,000 ft. because of the nature of the ground.

A *pumping head* of 3153 ft. is an interesting feature of a small plant which lifts water from the Grand Canyon to two hotels, a power house, etc., owned by the A. T. & S. F. Railway Co.[48] Four vertical, centrifugal turbine-type pumps, each with seventeen stages, operate in pairs, giving 34 stages of 100 ft. per stage. Each is direct connected to a 60 h.p. motor. The pumping capacity is 170 g.p.m. The discharge pipe is 6 in. seamless steel tubing, which must withstand a maximum working pressure of 1470 pounds. Much of the pipe is exposed against the cliff and an electric thermostat has been placed at coldest section to give warning of danger of freezing.

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9. Interconnection of Electric Circuits with Water Piping Systems. J. B. Downer, pp. 212-225.
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12. t. Friction Losses in Bitumastic Lined Water Pipes. Charles W. Sherman, pp. 244-247.
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14. Improved Coagulation at the Richmond, Va. Filter Plant. Marsden C. Smith, pp. 254-259.
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16. The Syracuse Water Works. Marshall B. Palmer, pp. 264-274.
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22. t. Forests and Stream Flow. Discussion; N. C. Lowdermilk, Rhodes E. Rule and R. E. Kennedy, pp. 484-494.
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26. Cutting W. W. Department Expenses, pp. 147-149.
27. t. Hydraulics of Rapid Filter Sand. Roberts Hulbert and Douglas Feben, pp. 150-151.

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28. Chicago Builds a New Water Works Tunnel, pp. 186-187 and 211.
29. Cutting W. W. Department Expenses, pp. 190-191.
30. Increasing Efficiency of Sedimentation Basins. F. P. Larmon, pp. 207-208.
31. Ammonia-Chlorine Treatment Used on East Providence, R. I., Supply. James V. Turner, pp. 208 and 210.

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33. $4,000 for Leakage Survey Saves $500,000 in Water. A. R. O'Reilly, pp. 45-46.
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41. Evaluation of Powdered Activated Carbon for Water Works Use. Martin E. Flentje, pp. 86-88.
42. Water Treatment on Pacific Lines of Southern Pacific R. R. Dennistoun Wood, pp. 92-94.
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48. Pumping Plant with 3,153 feet Lift at Grand Canyon, pp. 343-344.

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Activated Carbon Removes Taste and Odor from a Water Supply

The presence of an unpleasant taste and odor in a public water supply in New York State recently presented an interesting problem.

The supply in question is prechlorinated, treated with activated carbon, filtered and postchlorinated. Hence there was no question as to the sanitary quality of the water. On investigation, it was found that the odor complained of was geranium-like in character, and microscopical examination disclosed the presence of a large number of *Asterionella*.

These findings were unusual because tastes due to algae are usually removed by heavy chlorine doses, filtration, and treatment with small doses of activated carbon. Laboratory experiments indicated that treatment of the water with one-half grain of activated carbon per gallon would remove the taste and odor, and it was recommended that the dose applied to the filtered water be increased from 0.3 grain per gallon to 0.5 grain per gallon, which corrected the difficulty. This experience is another example of the effectiveness of activated carbon treatment in the removal of objectionable tastes and odors from public water supplies.—*New York "Health News."*

THE EDITOR'S PAGE

First Things First

In devoting considerable space in this issue to the maintenance of roads, we have no desire to discourage new construction if there is money available for it after maintenance has been taken care of. But there are so many reasons why the latter should be given first consideration, especially at this time, that a full appreciation of them seems to us to be very important.

From the financial point of view, a dollar spent on maintenance, if spent in time, will give more mileage of good traffic service than two spent on new construction. But delaying maintenance repairs too long may allow a pavement to reach the point where the cost of repairs would be the greater. In repairing ravelling spots, potholes, etc., a yard in time saves nine. Continuous maintenance is the most profitable expenditure of the road dollar.

From the road user's point of view, also, maintenance minimizes discomfort and vehicle deterioration due to roughness and worse, of wearing-out roads. If a properly paved road is wearing out, this of itself implies considerable traffic, all of which will suffer from lack of maintenance.

Features of maintenance other than pavement repair may be fully as important; such as shoulder maintenance; keeping gutters clean and drains open; painting and maintaining guard fences, signs and other structures.

All maintenance work, but especially that last named, requires more labor per dollar of expenditure than does original construction, and this is an added reason for doing immediately all of it that may be needed, to help the unemployment situation.

A Statement by Thomas H. MacDonald

The Chief of the U. S. Bureau of Public Roads stated on March 27th, speaking of the tendency of state legislators to divert gas and other special motor taxes from highway purposes:

"Such contemplated reductions are serious enough to endanger both our large capital investments in highway construction and the technical organizations of our highway departments. These organizations must be protected to hold what progress we have made. *Our whole improved road mileage is absolutely dependent for its existence upon the day by day highly organized maintenance operations under experienced supervision and control.*

The public has no conception of the fragile character measured by time durability of perhaps 75% of our surfaced mileage. The fragile character of this mileage may be realized by my estimate that the lack of adequate maintenance would be seriously noticed on 75% of our road mileage within 30 days; within six months we would be losing money so fast (through depreciation and drop in gas tax revenues) that we would soon not have enough money to take care of the fixed charges and maintenance alone—to say nothing about ruining our chances of even approximating the upwards of a billion dollars income from the road user taxes obtained last year from adequately maintained roads.

This is a nationally vital concern; it is impossible to overstress the hazard to the public's interests in any breakdown of maintenance and technical control by highway departments."

What City Engineers Are Interested In

Fully eighty-five percent of the city engineers of the country are interested in paving and other highway work, and seventy-six percent are interested in sanitary engineering. Or, to put it in another form, only fifteen percent are not especially interested in paving and only twenty-four percent are not interested in sewerage and water supply.

These figures are based on direct statements made to PUBLIC WORKS by 651 city engineers of cities of all sizes, from 5,000 population up, in connection with a survey of reader interest which this magazine is making. Replies are still coming in, but sufficient are in hand to afford a representative analysis of what subjects are of especial interest to city engineers.

These are the leading but by no means the only subjects reported.

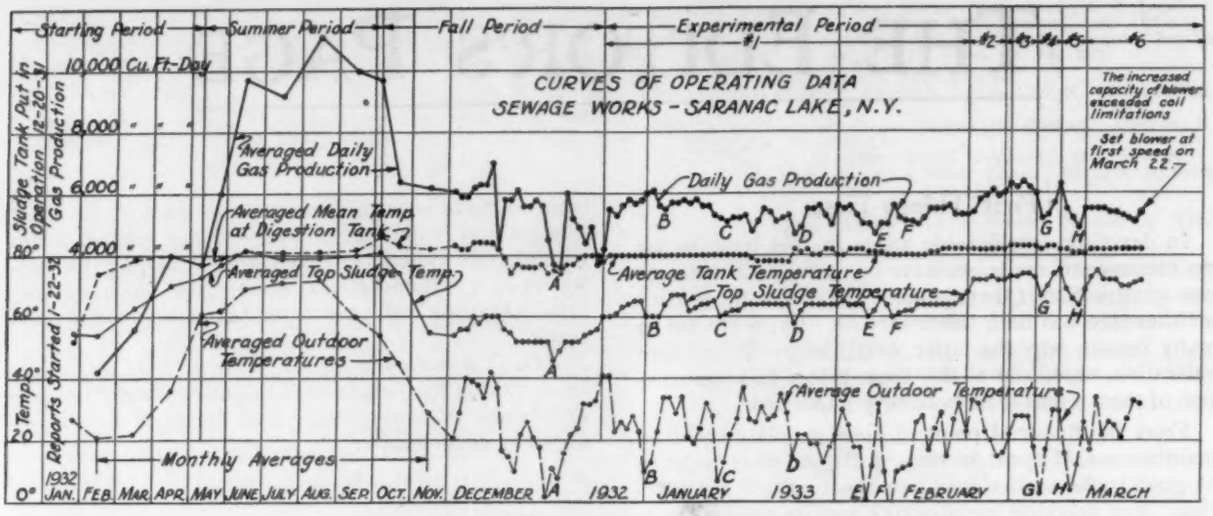
Interest in concrete construction was expressed by twenty-five percent, and in retaining wall design by twenty-two percent. There are also refuse disposal and street cleaning; bridges, and many other subjects which demonstrate the well-rounded qualifications that a city engineer must possess.

These figures prove what we have always believed most firmly—that the needs and interests of city engineers can not be met by a magazine specializing on a single portion of the field. We thank the hundreds of our readers who, in replying to our questionnaire, have confirmed the correctness of the policy we have followed, during thirty years of editing and publishing this magazine, in endeavoring to meet fully the needs of engineers engaged in the public improvement field.

Municipal Finances

Newspapers have made much of the financial troubles of the few cities that have spent their huge incomes unwisely, but for every city in difficulty today, there are twenty that are in perfectly sound condition, and fully able to meet their obligations, carry their payrolls, and continue needed construction work.

These cities will not discharge their trained and able engineers for a small temporary saving; they will not forget that needed and useful public works, built at the lowest cost obtaining for years, are now a better investment than ever; and that such construction will go far toward bringing back normal good times.



Curves of Operating Data, Saranac Lake Sewage Works

Heating Top Sludge

To Produce a More Uniform Rate of Digestion in Heated Sludge Digestion Tanks

By Henry W. Taylor

It is not necessary to state that the rate of sludge digestion is dependent upon temperature conditions after other requirements have been satisfied. In the case of unheated digestion tanks, there occurs a wide variation in digestive activity which follows seasonal variations in temperature quite closely. To speed digestion and to nullify the effects of weather changes, the heated digestion tank has met with favor on account of the resulting economy in required tank capacities. It has, however, become apparent that heated digestion tanks of standard design are also influenced by outdoor temperature variations, and a brief discussion of this problem and its solution are the subject of this article.

Seasonal Sludge Digestion

THE seasonal variation in the digestive activity in a heated digestion tank occurs in spite of the average tank temperature which may be maintained. Though there is proof of this statement at almost any plant, the effect of cold weather is more pronounced in the northern climates and the operating data from the separate sludge digestion plant at Saranac Lake, New York, will serve to illustrate the wide variations which may occur. It is, of course, necessary to observe all factors in the operation of a biological process before drawing conclusions. It is admitted that there are a great many factors in this or any case which enter into the variations in the rate of digestion and gas production, but due to lack of space limitations, many such factors will not be discussed other than to point out that their effect is minor in both theory and practise.

The accompanying table gives in condensed form some of the operating data from the Saranac Lake plant. The table is divided into several sections, namely the starting period, the summer period, the fall period, and the experimental periods. The first period is that during which the plant was placed in operation and data for this period can be somewhat discounted on that account, although they bring out the problem and suggest its solution. It will be noted from the table that there is no large variation in the sewage flow as represented by the KWH consumption at the pumping station. Similarly, there is no variation in the quantity of fresh sludge delivered to the digestion tank which would account for a reduction of over fifty per cent in gas production. The variations in pH are largely those resulting from different methods of field determination; the pH has been checked in the laboratory to prove its value well above 7.0. The slight variation, exclusive of the first period, in the average tank temperature will not account for the wide swings in digestive activity. Though the quantities under gas production have not been adjusted for temperature effects upon volume, this factor probably does not account for more than four per cent of the variation.

There are, however three distinct variables in the table, namely, outdoor temperature, top sludge temperature and gas production. It will be noted that these factors vary in parallel within certain limitations. With warm weather, the top sludge temperatures are high and gas production is high; while the reverse is true during the colder periods of the year, although the average tank temperature is maintained throughout both periods. It will be noted that the gas production varies in monthly averages in the second and third periods from 5332 cubic feet per day to 11,100 cubic feet per day. The variation on a daily basis was from 15,000 cubic feet per day on July 22, 1932, to 3,600 cubic feet on December 18, 1932.

The accompanying chart illustrates the same conditions in graph form. The first section of this chart is

Partial Operating Data: Sewage Works, Saranac Lake, N. Y.

PERIOD		Average Daily Kwh. at Pumping Station	Average Daily Fresh Sludge Cu. Ft.	pH	Average Mean Temperatures Out-doors	Top Sludge	Sludge Tank	Average Cu. Ft. of Gas Daily	Sludge Removal Total Cu. Ft.	Average Temperature Cover Attic	Heated Air to Attic Cu. Ft. per Min.	B.T.U. to Tank Av. Daily Millions
Starting	December 20, 1931—Sludge tank placed in operation.											
	Jan. 22-31	199	502	7.4	27	55	53		.....	..	..	2.41
	February	187	632	6.85	21	55	74	245	.....	..	..	4.3
	March	181	543	7.6	22	63	79	1,577	.....	..	..	3.9
	April	252	489	7.6	38	69	80	4,029	.....	..	..	2.5
	May 1-20	218	499	7.6	61	73	77	3,730	.....	..	..	2.2
Summer	May 21-31	190	554	7.8	62	77	80	6,027	7,700	..	..	2.2
	June	167	512	7.8	69	82	82	9,663	2,800	..	..	1.3
	July	167	572	7.8	71	79	80	9,165	8,400	..	..	1.2
	August	168	600	7.8	72	79	81	11,100	.....	..	..	1.6
	September	136	579	7.4	60	80	81	10,007	2,800	..	..	1.7
	Oct. 1-10	219	577	7.4	54	81	86	9,720	.....	..	..	2.2
Fall	Oct. 11-31	188	572	7.4	45	74	83	6,429	2,800	..	..	2.2
	November	196	559	7.4	29	57	82	6,192	2,800	..	..	2.0
	Dec. 1-25	190	532	7.4	24	55	80	5,332	....	36	..	2.4
Experimental 1st period	Dec. 26-31	213	560	7.4	28	63	80	5,617	2,800	53	20	2.4
	Jan. 1933	192	526	7.4	24	63	80	5,403	1,400	55	20	2.1
	Feb. 1-21	188	547	7.4	19	64	81	5,267	1,400	61	20	2.1
2nd period	Feb. 22-28	183	544	7.6	22	72	82	5,771	1,400	78	60	1.9
3rd period	Mar. 1-5	166	560	7.6	24	73	83	6,220	.....	81	60	1.8
4th period	Mar. 6-13	154	559	7.6	17	70	82	5,450	....	73	60-85	1.8

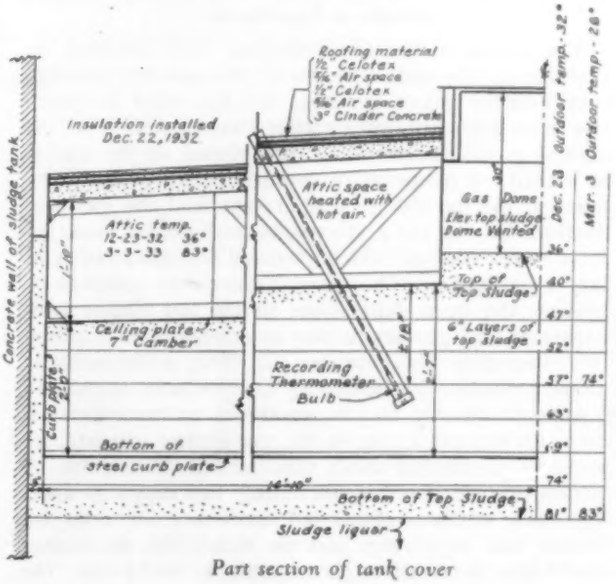
plotted on a monthly basis, and from December first, 1932, on a daily basis to indicate the sensitiveness of daily operation to these variable factors. The chart indicates the peak of monthly activity in the summer period and the rapid diminution which occurs during the colder months of the year. The gas curve, the top sludge temperature curve, and the outdoor temperature curve have the same characteristics except for range of change, while the tank temperature curve is practically a straight line except for the first period.

Causes of Variations

It is agreed that for rapid digestion, other than thermophilic, a temperature of between 80 and 86 degrees must be maintained. These temperatures have been maintained in the body of the tank but have not been maintained in the top sludge. It seems necessary to reconstruct the original conception that a scum will form just under the cover of a sludge digestion tank, and substitute therefor the probability that there will be, underneath the cover, a top of supernatant sludge several feet in thickness. A large volume of the sludge settles to the bottom of the tank and stays there unless over-agitated and forms a bottom sludge. Between these two layers of sludge, top and bottom, there occurs the "supernatant liquor," which might better be called simply sludge liquor. The top sludge contains elements which assist in flotation, such as greases and fats, and these elements contain per unit of volume the greater potentiality for gas production. It is apparent that the top sludge is not successfully heated by the temperatures below it, and that warm weather is required before the top sludge can gain sufficient temperature to become active. During the colder weather, this top sludge is stored for future digestion when the season permits.

The actual conditions existing in the top sludge during cold weather are illustrated by the accompanying diagram showing a part section of the digestion tank and cover. The temperatures taken on December 23, 1932, with a recording thermometer are shown on the diagram, together with the outdoor and attic temperatures. It is obvious that heated digestion could not take place in this sludge under these conditions, and that there is in this chilled and stored top sludge, an inactive, but potential, gas producing capacity.

Although digestion takes place on the return of warm weather, there are many reasons for attempting to rectify these wide variations and provide for a more uniform digestive activity. A heated digestion tank is no fit place for storage of inactive digested or undigested sludge; economy requires that the contents of such a tank, except that required for seeding, be actively digesting throughout, since slow digestion, secondary digestion, two-stage digestion and concentration can be accomplished in tanks of less cost. A considerable layer of top sludge complicates operation. Excessive rates of gas production are of little value in the summer time, while increased flow of gas is often paramount in the winter time. Large variations in gas production are accompanied by sludge foaming and result in overtaxing of accessories, blowing of seals, and involve expensive allowances in design. If gas is being used for power, for building heating, or is being sold, an average rate of production without wide variations is an asset.



Part section of tank cover

An excessive top sludge will decrease the submersive effects of any cover and will gradually become compact and unwieldy.

The Solution

Various experiments have been tried at this and other plants to produce activity in this top sludge during cold weather. An occasional attempt has been made to heat the top sludge with a jet of hot sludge liquor, without particular success. On isolated occasions, bottom sludge has been pumped or circulated with the idea of seeding the top sludge, if it needed it, but the results from these trials in no way warranted the repetition of the experiment. It was decided, in the case of three plants, that the solution lay in imitating summer conditions in the cover and that it was necessary to have the temperature conditions in the cover under the control of the operator.

At Saranac Lake the digestion tank is equipped with a Downes cover, which is shown in part section in the diagram. It will be observed that there is what might be termed an attic space between the ceiling plate and the weather roof. This attic lends itself to hot air heating, and the exhaust burner provides an opportunity to divert waste heat to a useful purpose. A coil was installed around the waste burner and a blower supplies air to the coil and hot air to the cover attic. The first blower installed during the experimental period was inadequate. Also it was found that a sudden change in outdoor temperature quickly reduced the temperature gain in the attic, and the roof was therefore insulated as shown in the diagram. During this period several blowers and arrangements at the waste burner were tried out and on February 22, 1933, a suitable blower and waste burner arrangement were put in operation. The new blower was belted to a motor and run at half speed for the first two weeks. The accompanying diagram shows the attic space into which the hot air was delivered and indicates that a layer of warm air was introduced between the top sludge and the outdoor temperature conditions. It is apparent that this heated area will serve as an active agent for heating the sludge from the top, while the average tank temperature serves as an active agent below the top sludge, and that a gradual equalization, operating from both directions, must eventually take place.

Results of Experiments

The curves on the accompanying chart indicate the problem in the wide swings of the monthly average curves on the left of the chart and also show the problem in its daily application after December 1, 1932. At critical points letters have been placed on the curves to identify a temperature condition that seriously influenced the top sludge temperature and the gas production. During the first experimental period, some results were obtained which justified the installation of larger equipment. The small blower was sufficient to prevent the deep depressions in the top sludge temperatures and gas production as compared with previous experience. On February 22, 1933, a Connersville blower, number 36, operating at a reduced speed and a capacity of only 60 cfm. produced an immediate effect and started a rise in the top sludge temperature and gas production which continued to March 4th. A period of cold weather, including two drops to average zero weather, demanded more hot air than the blower was supplying, and on March 9th the blower speed was increased to give a capacity of 85 cfm. The experimental coils are only two inches in diameter and the latter capacity of the blower represents about the limit of the coil capacity.

It will be noted that when the capacity of the heating equipment proved inadequate to counteract the weather temperatures, the effect on gas production was immediate. It was intended to increase the gas production to about 8,000 cu. ft. per day and then stop the blower and top sludge heating to prove that this heating was the essential element in the increase of gas. The weather took the matter into its own hand, however, and provided a demonstration in the fourth experimental period, when the temperature of top sludge suffered a decided drop and the gas production followed this drop. It will be noted in the table that even during this cold weather the average tank temperatures were maintained without any increase in the Btu supplied to the hot water coils in the tank. The pronounced effect of the weather appeared in the top sludge temperatures and the gas production. It is also apparent that this effect of the weather down from the top is bound to occur with any type of top structure, partially back filled or not.

If this rapid change in temperature had occurred a little later in the experimental periods, there would have been more excess gas to counteract the condition, producing higher temperatures in the hot air delivered to the attic of the cover. Any reduction in the total gas reduces the gas available for the exhaust burner and the heating of the air for the attic, and there results a vicious circle. It must also be added that no material increase in gas production is expected until the top sludge temperature has been maintained at above 76 degrees for several days. These top sludge temperatures were recorded by a Bristol thermometer with bulb about eighteen inches below the ceiling plate. It is probable that, prior to the publication of this article, no striking increase in gas production will occur.

With present coil limitations, demonstration is subject to the degree of cold which these limitations can counteract. However, subsequent and more picturesque results will no doubt be available for the second article on this same subject, which will appear in May and will include the experience at the plant at Rome, N. Y. The Rome heating equipment was started on March 14, 1933, and includes 3-inch coils, a blower with 120 cfm capacity and no insulation for the floating cover.

Acknowledgment is made of the assistance given by the Pacific Flush Tank Company, the Connersville Blower Company, and the Pittsburgh Equitable Meter Company, together with the co-operation of Mayor Seaver Miller, City Manager Wayne E. Timmerman and the Board of Trustees of the Village of Saranac Lake, and the special work done by the plant operator, Harry Miller.

Discharge of Sewage Into Creek

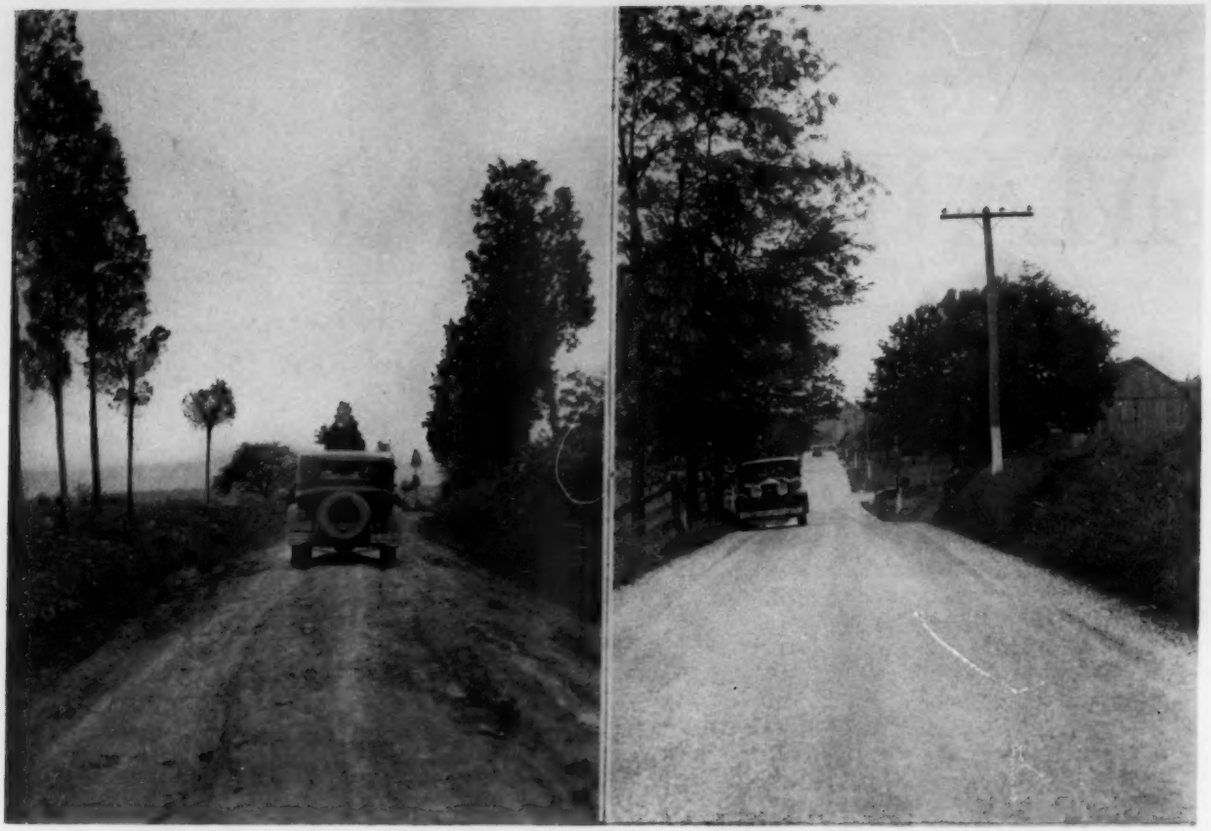
The Oregon Supreme Court holds, Miller v. City of Woodburn, 294 Pac. 349, that, while a municipal corporation does not have the right to increase the natural flow of a stream or to pollute its waters to the material injury of a riparian owner, a person who would enjoin a city from discharging sewage into a creek, where public convenience is materially involved, should be required to show that the matter complained of is of more than trivial consequence, and that he has a strong right to relief.

MAINTENANCE

Conserving Our Highway Investment

"When I began my second term as Governor of Pennsylvania in 1931, about three-fourths of the State's farms were on unimproved highways. More than 127,000 farmers, with their families and employees, were living under a ban of excommunication. . . . Between January 20, 1931, and November 15, 1932—the first twenty-two months of my present administration, the State Highway Department constructed 6,643 miles of road, or three-fifths as many miles as had been put down in all of the preceding twenty-two years. Almost five thousand miles of these roads had been hard surfaced at an average cost of $6,000 per mile. All the remaining 15,000 miles had been brushed, widened and drained pending further improvements. . . . We have had as many as 55,000 men working on the roads at one time. The Department of Highways is one of the biggest employers of labor in Pennsylvania, and the biggest work relief organization in the United States." . . . *Gifford Pinchot.*

The First of a series of articles stressing to-day's needs for maintenance as the means of conserving and protecting our highway investment.



Pennsylvania Route 24. Picture at left shows unimproved section. At right is completed road. Pictures taken from same point, but facing in opposite directions.

Meeting Pennsylvania's Highway Needs

***Written especially for* PUBLIC WORKS**

By Gifford Pinchot
Governor of Pennsylvania

WHEN I began my second term as Governor of Pennsylvania in 1931, about three-fourths of the State's farms were on unimproved highways. More than 127,000 farmers, with their families and their employes, were living under a ban of excommunication. The State was ignoring them, and was confining its roadbuilding activities largely to tearing up good surfaces on main highways merely to put down somewhat better ones.

I had proposed in my campaign that Pennsylvania lift its farmers out of the mud by taking over 20,000 miles of second class township roads. I had promised that if this were done, the State Highway Department would put down roads that could be traveled over 365 days a year. I was laughed at at the time, and my plan was called humanly impossible.

But the Legislature which convened in 1931 took over that mileage with only one dissenting vote. The State Highway system was thus increased to 34,145 miles—enough road to reach all the way around the earth at the Equator, and then go through the center of the earth from Pole to Pole.

Between January 20, 1931 and November 15, 1932 —the first twenty-two months of my present administration—the State Highway Department constructed 6,643 miles of road, or three-fifths as many miles as had been put down in all of the preceding twenty-two years. Almost five thousand miles of those roads which were on the 20,000 miles taken over had been hard-surfaced at an average cost of approximately $6,000 per mile. All of the remaining 15,000 miles had been brushed, widened, and drained pending further improvement.

Taking over for improvement and maintenance those township roads made an annual direct saving of about $2,500,000 in local taxation. Those townships which did not reduce their road tax as a result of the transfer found themselves with approximately one-third again as much money for their remaining road mileage—and with no increase in tax rate.

More than that, Pennsylvania's highway operations have provided a tremendous amount of work relief during the last two years. Exclusive of the Department's salaried employes, we have had as many as 55,000 men working on the roads at one time. The Department of Highways is one of the biggest employers of labor in Pennsylvania and the biggest work relief organization in the United States.

Moreover, our rural road program has been developed at no sacrifice to continued development of main arteries and connecting links. During the last two years we have built 1,500 miles of these.

Our program to date has met with such signal success that I have asked the Legislature to take over 53,000 remaining miles of roads in second class townships. When this is done Pennsylvania farmers will be on their way out of the mud for good and all.

A section of the road described on page 25. In the background is the old road. Contrast it with the widened section in the foreground.

Planning Your Highway Program

By W. A. Hardenbergh

THE highway system of your community is undoubtedly the greatest single physical asset of that community, representing the expenditure of a tremendous sum of money. A statement of the expenditures made during the past ten years for street and highway construction in your city, county or state would probably surprise the majority of your taxpayers —possibly even yourself.

You, as state highway engineer, county commissioner or engineer, mayor, councilman or city engineer, are responsible for conserving the public's investment in highways. This is a responsibility that cannot be evaded, and your trusteeship requires that you administer most carefully the sums intrusted to you.

An analysis of the financial requirements for your 1933 highway program will show that, essentially, your road money must:

1. Pay interest on money borrowed previously for road construction.
2. Maintain substantially unimpaired the capital value of your highway system.
3. Further improve those highways that are now in an uneconomical stage.
4. Provide for vitally needed new construction.

These are substantially the priorities for your expenditures, though the amounts or percentages allotted under each head will depend almost completely upon local conditions. Likewise, the total amount will depend upon local conditions; this year it may depend very largely upon your ability to evolve a plan for utilization of unemployed labor which, while relieving unemployment, will not materially increase road costs. Elsewhere in this issue an article tells how one county engineer met this problem successfullv and is building highways for the future.

Many figures have been presented showing that more than 90% of the highway dollar goes to labor ultimately. You may be more interested in the fact that on certain types of maintenance work as much as 80% of it goes to *local* labor. Your problem is to so plan your work that in certain phases of it unemployed labor is utilized to greatest advantage, while in other portions of it, through the use of the most modern methods and materials, you obtain the maximum value in smooth-riding and economical surfaces.

Passing over, for the moment, this phase of the subject as well as that of debt service, about which nothing can be done, let us consider the details in connection with the priorities already outlined.

Maintaining the Capital Value of Your Highway System

The several million dollars which your city or your county has invested in highways and streets must not be allowed to depreciate in value. The good citizen keeps his roof in repair, thus, by a small expenditure, preventing serious damage to his walls and furnishings; and by maintenance of his plumbing he eliminates the possibility of a heavy charge for an excessive use of water.

On certain types of roads, little expenditure is required for adequate maintenance. These are the paved surfaces, built of concrete, brick or bituminous materials. They are built for long service, and they will render it at a very small annual maintenance cost; yet maintenance is just as necessary for them as for any other type.

Maintenance of proper drainage is perhaps the most important factor, and provision must be made for keeping ditches and drains open, so that as far as possible opportunities will be eliminated for failure in sub-base or roadbed. Shoulder maintenance, crack-filling, patching of pot-holes, traffic striping and guard rail maintenance are other important items. The details of such work are covered in another article in this issue, so that discussion of methods is not necessary here. Using a skilled foreman, there is offered ample opportunity for the employment of considerable unskilled labor.

In general, the carrying on of this work ought to be just as much a standard procedure and just as much of a recognized necessity as the provision for debt service.

Improving Highways Now in an Uneconomical Stage

There are undoubtedly sections of highway which were, in accordance with your previous program, improved by grading and draining, graveling, or light

surface treatment, with the intention of adding later a surface in keeping with the traffic needs of that highway. This may be a short-cut, a link between two principal roads, or a cross-street, which, opened to the public, has attracted such a volume of traffic that maintenance costs with the present surface are too high. This happened last year in the county in which the writer lives. A road across a low range of mountains formed a short cut, providing access to an important village with a travel distance of only 9 miles as compared to the former improved road of 17 miles. Much traffic has been diverted from the roundabout route, so that it is practically impossible to keep the present dirt surface in travelable condition. Surfacing will be necessary, and is provided for in this year's plans.

Some of the more common conditions with which you may be confronted will include:

Earth Streets or Roads.—These may have been graded, drained and improved in regard to alinement, with the result that, serving a real need, the local traffic load has become so heavy that economical maintenance is no longer possible with an earth surface. A necessary step then is the addition of gravel or other available type of local selected surfacing; or, if that is not sufficient, a low-cost type of construction sufficiently strong to bear the load.

Gravel or Macadam.—Where the above conditions exist with gravel or macadam surfaces and the maintenance costs are such that it is uneconomical to keep these surfaces in condition, a surface treatment or mixed in place top should be added. Generally we may assume (if exact figures on maintenance costs are not available) that it is economical to protect the gravel or macadam surface when the traffic has reached somewhere near 250 vehicles per day. In the case of the best type of gravel and well-built macadam, perhaps as much as 500 vehicles per day may be carried economically.

Light Surface Treatments.—Light surface treatments on local surfacing materials is the next step up the scale. These may generally be relied on to carry up to 1,000 vehicles per day, under advantageous conditions. Again, the actual costs of continuing to maintain such a surface as compared to the construction and maintenance costs of mixed-in-place, or heavier, types must be weighed.

Generally your experience and the figures available on costs of maintenance of the various types in your vicinity are ample bases upon which to form the necessary judgment. The cost of replacement and maintenance of gravel, when traffic reaches as much as 500 vehicles per day, is generally such as to make it a real economy to surface-treat the road. In our next issue will be published some exact figures on this subject.

Double surface treatment on gravel in California.

Needed New Construction

In your locality, as in many others, there are undoubtedly gaps in high-type trunk roads which need to be closed. There are feeders to main highways which are vitally needed by the districts which these feeders will serve. Once more it is a question of your knowledge of local needs and of local traffic conditions. How much money is available for construction? What are the traffic loads that must be carried? What are the costs of maintenance on these gaps? What type of surface can be constructed that will best meet the needs of your situation?

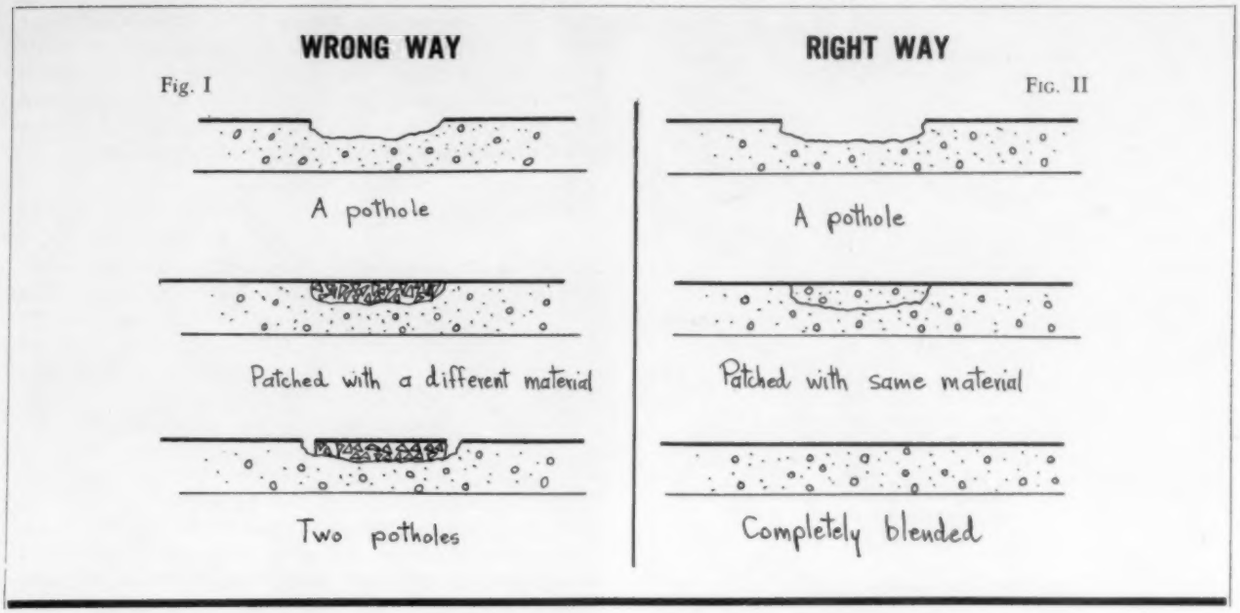
Is it possible to construct a mixed-in-place or retread surface that will economically serve this traffic? If the traffic is in excess of perhaps 1,500 vehicles per day, probably not. Then it will be cheaper, even though the first cost is high, to build a concrete, brick or sheet asphalt pavement. A surface inadequate to bear the traffic that will come on it is just as much poor engineering and a waste of money, as to build a high-cost pavement for 500 vehicles per day. In the first case, maintenance will quickly eat up any possible savings in first cost, while in the latter case, the depreciation and interest will far outweigh any low maintenance cost.

First Things First

If road construction and maintenance funds are inadequate to meet today's needs, it is in most states because gas tax and motor vehicle funds, honestly earmarked for highway construction and maintenance, have been diverted for other purposes. As short-sighted as this policy may be, it does not relieve you of the responsibility of conserving and protecting the public moneys invested in highways. In fact, it but emphasizes the great necessity of realizing this trusteeship and responsibility, and of planning most carefully to meet present conditions.

Great strides have been made in the past few years toward the utilization of modern methods and materials for all types of highway service. Those methods and those materials that are justified should be used. It is no time to save today's dollar at a cost of two dollars tomorrow through the use of inadequate surfaces; nor is it a time to spend two dollars when one dollar will do the work.

And in still another way and for another purpose, it is vitally important to keep our streets and highways in condition. Our revenues depend to such a great extent upon motor licenses and gas taxes that the industry cannot afford to allow highway conditions to discourage automobile travel. The sensible citizen—any citizen, for that matter—is not going to travel as many miles or use as much gasoline if the roads over which he has to travel are rough, dangerous and uncomfortable. Properly maintained highways encourage travel, even in the face of exorbitant gasoline taxes. Any temporary saving made by insufficient maintenance will be more than offset by a diminished return from gas taxes.



Details of Street and Highway Maintenance

By Bernard E. Gray
Illustrated by the Author

FOR roads already in existence there are two sound reasons for providing needed maintenance: One is to preserve the surface itself and prevent accelerated wear which always follows inadequate maintenance and which would require far greater sums of money than adequate, continuous maintenance. The other reason is that, if the road is permitted to get in a bad condition, traffic falls off to such an extent that revenues obtained from traffic become insufficient for even the barest necessities of maintenance.

Maintenance Requirements

The minimum maintenance requirements to preserve the present investment are:

1. Repair of holes.
2. Renewal of badly worn surfaces.
3. Maintenance of shoulders and ditches.

Patching as a general maintenance item is the most expensive part of maintenance work, but nowhere does the old adage of "a stitch in time" apply more forcibly. The repair of a small hole no "bigger than a man's hand" immediately after it appears, will prevent the ravelling of a larger area and the eventual expenditure of ten times as much. If no other work is done by a highway department, it will pay to exercise careful periodical scrutiny of road surfaces and to make repairs as soon as required.

Maintenance is needed on every type of surface from untreated materials up to the most expensive types of pavement, but the maintenance methods differ according to the different classes of road surfaces. Untreated surfaces are better maintained by frequent blading of the surface than by patching, and if they have become full of pot-holes, the best procedure is to scarify them lightly during the spring season and then blade the surface frequently until a uniform consolidated condition is obtained. Blading at intervals throughout the remainder of the year will prevent further pot-holes.

With the more improved types of surface where pot holes are infrequent, patching is economical. A cardinal principle in this regard is that the patch should be made as nearly as possible like the material of the original road surface. See Fig. I-Fig. II. In other words, if the original road is a gravel road, then patch with gravel; if a waterbound macadam, patch with waterbound macadam; if road-mix surface, patch with the same size of aggregate and approximately the same percentage of bituminous material pre-mixed and placed in the hole. With the monolithic types of construction, patching material should approximate the same density as the adjacent pavement, so that traffic impact is the same on the patch as on the surrounding area.

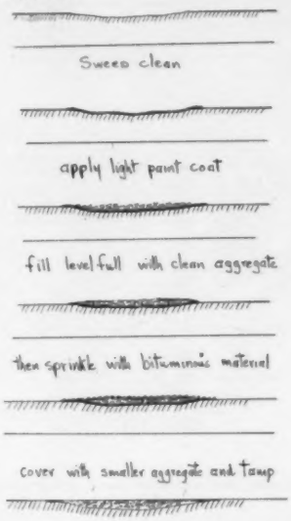
The preparation of the hole for patching is extremely important. There is no advantage in patching a hole in the surface if the hole has been caused by a faulty condition of drainage, as in a short time the hole will reappear. Also there is no benefit gained by making the patch stronger than the original surface. A surface treated gravel or macadam road, with a surface ½" thick, repaired with a bituminous patch three or four inches thick results in a hard spot in the surface of the road. Later, under traffic, the adjacent surface is pounded and a new pot-hole develops around the patch. The method of patching a thin surface treatment should be a little surface treatment in itself.

Patching

There are two kinds of patching. One is to restore a small depression to the same level as the adjacent highway. This is generally termed "skin patching." The other is the repair of pot-holes in the road surface. Skin patching is used for total depths of less than one inch, while the pot-hole may be of any depth but is usually around two or three inches. A pot-hole does not come fullfledged into existence, but begins first as a small depression and then under the differential impact breaks down and becomes a full-fledged hole. If a road is carefully patrolled therefore and the skin patching applied as required, pot-holes will be rare. These small depressions are due to either settlement of the subgrade or to differential compaction of the

The several steps in making a skin patch.

FIG. III


Sweep clean
apply light paint coat
fill level full with clean aggregate
then sprinkle with bituminous material
cover with smaller aggregate and tamp

wearing course. Insufficient drainage often leads to subgrade settlement with resultant deflection in the surface; sometimes an unsealed surface lets the water down to soften the subgrade, again leading to settlement. Before starting any patching operations, check carefully the drainage and make necessary corrections. It is a sheer waste of money to make repairs if the primary cause of trouble is not corrected.

Skin patching does not require the removal of the present surface, but it does require thorough cleaning and usually a light paint coat to insure complete bond with the thin patch to be made upon it.

There are two methods of patching. One is the patch-in-place, where the dry aggregates are placed first, followed by an application of the bituminous material. The other is the premixed patch where the aggregates and bituminous material have been previously combined in the right amount and then are placed as a finished mixture. As a general rule thin patching or skin patching can best be made by the patch-in-place method, principally because the dry aggregate can be feathered to a thin edge so as to get an exactly smooth surface, and by proper paint coating a thorough bond can be obtained at this thin edge. The steps are as follows: first, thoroughly clean the depression by sweeping; next apply a light paint coat of bituminous material; then place the dry aggregate in the depression and smooth to the same level as the surrounding surface; next apply a sufficient amount of bituminous material so as to thoroughly coat the patch without excess, at the same time lapping over the adjacent surface for about two or three inches beyond the outside limits of the patch; finally sprinkle small crushed aggregate over the patch and over the coated area around it and thoroughly tamp in place. See Fig. III. This method makes for a tight waterproof bond all around the edge of the patch and prevents water getting under the edge, tending to cause ravelling. By also coating the old pavement around the patch for a short distance, a transition between the old surface and the patch is made so that no bump develops.

Deep Depressions

For patching deep depressions or pot-holes, premix is usually preferable. It allows a better control of the density of the material, as well as of the amount of bituminous material. It permits the construction of a patch of approximately the same supporting character as the adjacent pavement and prevents fat spots or lean spots. For any type of bituminous pavement, the pot-hole should be squared up with perpendicular edges. All ravelled and dirty material should be removed back to the solid firm material of the old surface. For pot-holes over 1½ inches in depth, the patch should be made in two layers, the coarser size in the bottom and the finer size on top. Patching mixture should be of approximately the same character as the old surface, and this premixed material should be placed in the hole and levelled with the old surface, thereafter being firmly tamped and placed. By squaring up the edges of the hole, a firm bond is obtained with the old surface and the possibility of ravelling is largely prevented. The final layer of patching material should be thin and of a finer texture, so that under traffic it soon consolidates and becomes thoroughly waterproof, binding in with the old road surface. See Fig. IV.

The following are the asphaltic materials recommended for patching purposes where the road surface is of gravel, shale, top-soil or waterbound macadam: Asphaltic Material MC-1, as a primer, and allowed to soak in thoroughly; then RC-2 rapid-curing material, covered with the same character aggregate as used in the original surface and thoroughly tamped. Asphaltic material RC-2 is recommended for skin patching on road-mix, penetration macadam, concrete and brick surfaces. For such repairs, after cleaning, first apply a paint coat of RC-1; then enough crushed aggregate to just fill the depression; then a sprinkling of RC-1 over the aggregate and around the edge; and finally, a sprinkling of the fine aggregate and thorough tamping.

Premix Patches

The materials for a premix suitable for patching

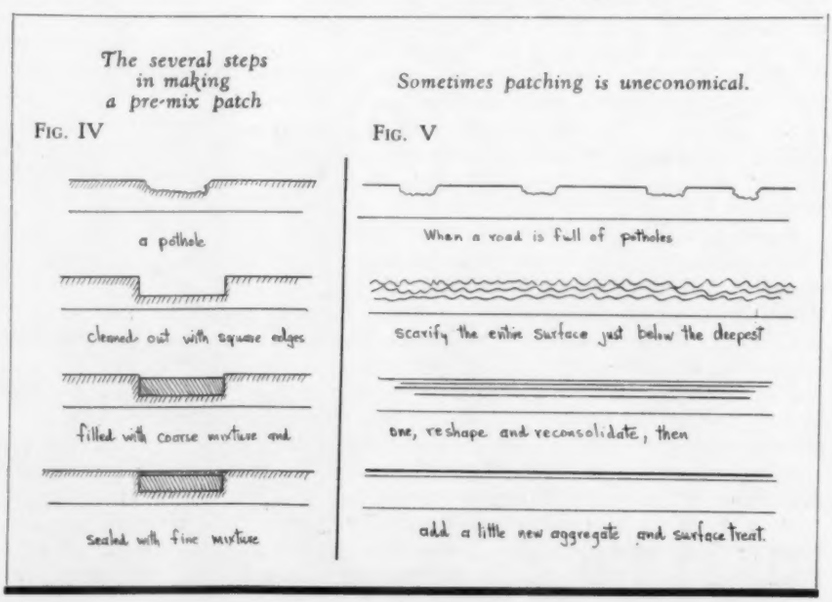
(Continued on page 28)

The several steps in making a pre-mix patch

FIG. IV

Sometimes patching is uneconomical.

FIG. V


a pothole
cleaned out with square edges
filled with coarse mixture and
sealed with fine mixture
When a road is full of potholes
scarify the entire surface just below the deepest
one, reshape and reconsolidate, then
add a little new aggregate and surface treat.

At the left is the mixing plant; the finished surface, 20 feet wide, is shown at the right

A Pre-Mixed Tar Slag Resurfacing Project

By Geo. E. Martin

Consulting Engineer, General Tarvia Dept., The Barrett Co.

A PLANT-MIX job about five miles long, using Re-Tread size aggregate and tar binder, was built by contract in the fall of 1932 in Trumbull County, Ohio, on 5.6 miles of State Route No. 5 north from the south village limits of Cortland.

The existing road was a surface-treated macadam 14 feet wide. Before the new top was placed this was widened to 20 feet with water-bound macadam and the widened sections treated with a prime coat of refined tar having a specific viscosity at 40° C. of 10 to 20.

The mixing was done at a central mixing plant located at the slag plant of the Carnegie Steel Company at McDonald, Ohio. The mixing plant consisted of a 40-ton steel Heltzel aggregate bin with a 1000-pound twin pug-mill mixer located underneath the bin at the outlet; both being elevated to a sufficient height to provide for truck clearance under the mixer. From a supply tank erected alongside the bin and above the mixer, the tar was fed by gravity into a graduated volume meter and then to the mixer, being discharged so as to spread over the entire width of the mixer at the same time. A 30 horse power electric motor was used to drive the mixer. The aggregate was placed in the bin by means of a ¾ cubic yard, steam operated, clam-shell traveling crane. The tar was trucked from the Youngstown plant of The Barrett Company to the mixing plant in a regular Tarvia distributor, and was forced into the supply tank by air pressure furnished by the truck.

The materials used on the surface course were, as specified in the contract, Ohio size No. 34 slag aggregate graded from ¼ to 1½ inches. The binder was Ohio bituminous material tar M.T.1, having a specific viscosity at 40° C. of 45 to 65. These ingredients were mixed in 1,000-pound batches, of which approximately 5½% by weight was tar. The slag was reasonably dry at all times, but no difficulty was experienced in obtaining a proper coating, even when the slag was damp. The tar was kept at an average temperature of 150°F.

A pre-mixed seal coat was used, consisting of ½-inch size slag chips coated with tar.

The mixed material was hauled about fifteen miles in five-ton dump trucks to the job. There it was dumped into Galion macadam stone spreader boxes, two boxes being used, one on each side of the road. The material flowed readily through the boxes.

Most of the mix was finally spread and placed by a Gledhill attachment on a grader drawn by a tractor, but on a portion of the work a Troyer-spreader, twenty feet wide, was used. In both cases the material worked easily and very little hand work was needed to line up the edges. The mix was allowed to cure for twenty-four hours after spreading and was then rolled with a ten-ton roller. The surface course was approximately two inches thick after compaction.

The coated chips used for the seal coat were spread at the rate of eighteen pounds per square yard, by means of an N. & H. chip spreader attached to the end of the truck bodies. The chips were then dragged with a light drag and rolled into the voids. On two small sections, a second liquid seal of one-tenth gallon of tar per square yard was used as an experiment.

A total of about 6,000 tons, or 195 pounds per square yard, was used, including the seal coat chips.

An average of about 325 tons of mixed material was produced at the plant each working day.

The entire job was done during the month of October. The temperature varied from 38 to 68 degrees. The amount of material handled per day varied from 60 up to 404 tons of mix, depending somewhat on temperature, weather, and working conditions, but averaging 278 tons. The 883 tons of seal coat was placed in five days.

The finished re-surfacing produced a smooth but non-skid surface with the appearance and easy riding qualities of a well built Re-Tread mix. The experimental sections where a second liquid seal was used show that either this method should be followed or a liquid seal should be used instead of the pre-mixed seal.

The work was done by The Mahoning Contracting Co. of Warren, Ohio, under the direction of the Ohio State Highway Department. The average cost was $11,776 per mile for the widening and the re-surfacing.

Widened, surfaced and ready for a seal coat, this road is typical of results attained by modern methods.

Economics of Maintenance and Reconstruction

By C. N. Conner

MONEY spent for upkeep gives quicker and greater returns on the investment than any other equal expenditure made for road work. Proper and thorough upkeep of roads not only conserves the public investment in the improvement but it also provides safety, economy and comfort for traffic. Maintenance saves dollars already invested in roads that without maintenance will be washed away by rains or blown away by the winds.

The funds available may be sufficient only for gradual improvement of the highway system, but many miles of lower type road, while waiting for improved surfacing, can be made to serve existing traffic by well directed maintenance. Any curtailment of maintenance which will result in impairment of the roads already constructed, or which will increase the cost of transportation of products, is very short-sighted economy.

Road and bridge budgets should be carefully studied with this principle in mind to avoid future road repair bills or an increase in transportation costs which will be greater than the savings made.

Maintenance Requirements

For discussion of the economic value of maintenance, roads may be divided into three types:

1. The pavement types, on which maintenance costs are low and traffic is high.

2. The gravel, slag and stone types, either treated or untreated with bitumen, on which maintenance costs are higher than for pavements and on which traffic is lower.

3. The earth road or unsurfaced soil types, on which only maintenance can be justified, because of the small number of vehicles which use them.

Large volumes of traffic are carried on modern pavements without serious wear on their surfaces, while their thickness and strength are usually sufficient to resist unfavorable soil and climatic conditions. Thus the maintenance cost on such surfaces is low — commonly less than $200 per mile per year, even when several thousand vehicles use them daily.

But these hard-surface roads comprise less than 5 per cent of the highway system; only 145,000 miles in a total of 3,000,000. The balance comprises 585,000 miles of other improved highways and 2,200,000 miles of unimproved roads.

The annual maintenance cost on gravel, slag or stone highways, if they are untreated with bitumen or chemicals, will be high when they carry more than 500 vehicles daily. It may be as much as $600 for a mile of ordinary gravel road when carrying only 500 vehicles daily. But when treated with bitumen, this same gravel road will carry 1,000 vehicles daily for the same $600 of annual maintenance.

The Forgotten Roads

But what is to be done on the 2,200,000 miles of unimproved roads which carry less than 100 vehicles per day and for which no money is available or warranted for pavement, bituminous surface-treatment, or even just plain gravel? These are the forgotten roads known only to the forest ranger, the small farmer and the rural mail carrier; and yet these roads and trails are just as valuable to them as the trunk line boulevard is to the city dweller. They are more important, in fact, because these isolated dwellers have only the local road as a means of communication, while the city dweller has his highways, street railways and railroads.

Justifiable Investment

Economists tell us that, in order to justify a given investment in road building, the annual road cost must be balanced by the money which the improved road saves motor vehicle owners in the cost of operating their motor vehicles, by the economic and social needs which it supplies, the real estate enhancement and community development.

Annual road costs are made up of three items: Maintenance cost; interest on construction cost; and the cost of replacing those portions of the constructed road which cannot be preserved by maintenance operations alone.

Since the justification for building a road depends upon the extent to which it is used, we must conclude

(Continued on page 49)

Low-Cost Roads and Unemployment Relief

By R. B. Traver
County Superintendent, Onondaga County, N. Y.

A typical calcium chloride treated gravel road.

AT THE beginning of the last fiscal year, our Board of Supervisors advised me that our highway funds would be greatly reduced and that we would be expected to come through with a plan for the year of 1932 which would about triple our employment. In order to do this very little of our available funds could be expended for materials—not more than 10% of the total. We remonstrated with them, claiming that if hand labor alone was resorted to, the cost of the work would be from four to five times more than it would be in normal times; however, the Board won the argument inasmuch as they held the purse strings.

Plan Adopted

After careful study we recommended the adoption of a plan involving the use of stage construction. This plan, which was approved by our Board of Supervisors, consisted of the following:

(1) New construction work for next few years to be confined wholly or mainly to preparation of county roads for paving, the pavements to be laid when and if traffic and budgets warrant.
(2) Grading and alignment of these roads as though they were to be paved at once.
(3) Installation of drainage systems and structures, guard rails, etc.
(4) Surfacing of roads for immediate use with bank run of gravel spread to a width of 20 feet, 9 inches thick in center decreasing to 5 inches at the edges.
(5) Treatment of gravel with surface binder and dustlayer.
(6) Maintenance of these gravel roads.
(7) Employment to be provided for approximately 1,000 men, or about three times the number usually used during construction period.

In the surfacing of the fifty miles of roads constructed in accordance with this plan, we found it necessary on several projects to add either sand or clay to the gravel which we have available in order to assure proper consolidation of the wearing surface. The greater part of the gravel available in our district is not what would be classed as good road building material, being either too fine or too coarse and in many cases without sufficient fines to act as a binder.

Treatment With Calcium Chloride

We decided on calcium chloride as the best surface treatment for roads of this type and applied the flake material at the rate of 1½ lbs. per square yard. While we applied the calcium chloride primarily as a dust layer, we are now convinced that the value of this material as a binder and means for consolidating the surface metal is even greater than its generally accepted value as a dustlayer. We have found that the combination of moisture, which calcium chloride adds to the surface and the action of traffic will, in a short space of time, consolidate the surface into a solid mass, necessitating very little maintenance and making the surface almost impervious to the elements. In one or two instances it was necessary to build these gravel roads on as high as 10% grades, and we found that the calcium chloride through its binding properties, when acting in conjunction with the clay loam, was able to hold the surface in nearly perfect shape against the heavy rains of early and late fall and, at the same time, to carry from twelve hundred to thirteen hundred vehicles.

There did not seem to be any great difference in the final results obtained, whether we applied the chloride in wet or dry periods. We found that in our late season's work, even as late as the middle of December, the benefits obtained by the application more than offset the slight cost. On two projects, half of each road was left untreated, and in each case the section untreated is at present almost impassable, due to the failure of the gravel to properly compact itself without the assistance of the calcium chloride.

When we adopted the gravel road program it was anticipated that a certain amount of top dressing with fines would be necessary two or three times a year and had included this item in our estimate, but now we find that if the binder is used properly it eliminates this anticipated yearly expense. Our program for maintenance now provides for the application of one lb. of calcium chloride per square yard in early summer season, followed in the midde of the summer by another application consisting of ½ lb. per sq. yd. Scraping or honing is done only after heavy rains so as not to waste any

of the calcium chloride. Our experience has shown that after the heavy rains this is driven to some depth into the gravel, but as the road dries out it gradually returns to the surface.

Success of Program

When our program was first announced, we were threatened in a number of instances with taxpayers' actions or injunctions to prevent us from building this type of road. It is interesting to note that the residents along the fifty miles of roads completed, who were among those violently opposed to the program, are now more than pleased.

In view of the results obtained by the adoption of this program for construction during the season of 1932, and as a result of the hearty approval of the residents along the various projects, the Board of Supervisors have authorized an extension for 1933, covering an additional fifty miles.

Conclusions

Upon careful study of the results of the year's work we have found that we have accomplished several things beyond those which we expected to. The results might be briefly summarized as follows:

(1) We have furnished the taxpayers with well drained, properly aligned, usable roads which can be developed into high-type roads at a relatively low cost when conditions warrant.

(2) We have furnished employment to three times the number of men used during normal times.

(3) We have gained the good will and approval of both the welfare commissioners and the taxpayers of the county through being able to confine the expenditures for materials, including gravel and calcium chloride, to $500 per mile or less.

(4) We have been able at least to relieve the pressure for diverting highway funds to relief agencies by materially reducing the call for relief. Approximately 400 families were taken care of through our projects at a cost less than they could possibly be taken care of under relief agencies. A careful analysis shows that the 400 families were taken care of at a cost per family of $30 per month. This was chargeable to our excess cost of operation. Our Board of Supervisors and the taxpayers of the county both appreciate the fact that our labor is costing us approximately three times what it should under normal methods of construction, but they feel that the fact that the residents of the county are employed in a work whereby they can see the results accomplished and the fact that the results are beneficial to the county as well, is much better than any other unemployment relief work which is put forth with the sole purpose of taking care of the unemployed regardless of the value of the work accomplished.

This paper was delivered by Mr. Traver at the meeting at Atlantic City, N. J., of the Association of Highway Officials of the North Atlantic States.

Traffic Paints

A series of paint materials for traffic markings on highways and streets, designed to stand up under the difficult conditions existing in markings such as these, has been developed by the Finishes Division of the du Pont Company. Tests were made in six states under various traffic conditions to determine how long it took for the paint to dry tack free and also how long to dry hard. It was found that four of them showed characteristics of drying in approximately the same short time as lacquer type materials. Others took somewhat longer. Three colors were used, white, yellow and red. Because of the severe tests demanded of these traffic marking paints, considerable care was taken to try them out where many different climates would be encountered. The tests ran from Texas and California to Ohio, Pennsylvania, Massachusetts and North Carolina.

Details of Street and Highway Maintenance

(Continued from page 24)

deep holes and for patching the edges of pavement would be as follows:

Coarse Mix

1½" x 2¼" crushed aggregate	60—80 per cent
¾" x 1½" crushed aggregate	17—36 per cent
Bituminous material	3— 4 per cent

8 to 10 gallons per ton of aggregates

Intermediate Mix

¾" x 1½" aggregate	65—87 per cent
⅜" x ¾" aggregate	10—30 per cent
Bituminous material	3— 5 per cent

8 to 12 gallons per ton of aggregates

Fine Mix

⅜" x ¾" aggregate	0—25 per cent
⅛" x ¼" aggregate	51—83 per cent
Passing ⅛" screen	10—25 per cent
Bituminous material	7— 9 per cent

16 to 22 gallons per ton of aggregates

Reconditioning

There are occasionally road surfaces where pot-holes have become quite numerous such as certain residential streets of small cities and towns where the surface falls short of being adequate to support steadily increasing traffic. Continued patching of such a surface is a wasteful procedure, because as fast as one hole is patched another one breaks out somewhere else. The average engineer dislikes to scarify an existing road surface because he feels that this will destroy the supporting character of the foundation. However, under these conditions, the most economical procedure is to scarify and reconstruct the old surface at the same time salvaging all of the inherent supporting value of the old base. Where many pot-holes are found, the maximum depth is seldom over three inches. Scarifier teeth should therefore be set so as to tear up the old surface just to the depth of these pot-holes, after which, by blading or raking, the entire surface may be brought to a uniform condition. It is surprising how much of such work can be accomplished by one man and a roller.

Over this surface should be spread a thin layer of new aggregate—usually one to two inches—followed with an application of screenings and a thorough rolling, and then about ½ gallon per square yard of bituminous material, followed by a seal coat at the rate of ¼ gallon per square yard.

Such a program of scarifying, adding a light layer of new aggregate and a bituminous treatment will bring a rejuvenation of this surface at a cost of less than $.25 a square yard. It will give traffic the surface that it requires and if, at some later date, a higher type surface should become necessary, the present surface will serve as an adequate foundation and all interim expenditures will prove to have been made to public advantage.

Part II, which will deal with surface treatments and making rough surfaces smooth, will appear next month.

A. S. T. M. Specifications for Calcium Chloride

The specifications of the American Society for Testing Materials for Calcium Chloride which cover material for application to the surface of highways as a dust preventive are being revised in order to enlarge the scope of the specifications to cover calcium chloride for a number of other purposes, including its use in curing of concrete and other applications in concrete construction.

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Colvin Road, Randolph County, Indiana. Surface-treated gravel.

The Barrett Company

New York	Chicago	Philadelphia
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Every community which subscribes to a "save what we've got" policy is irresistibly attracted to Tarvia economy and Tarvia performance.

With Tarvia, existing roads can be put into first-class shape quickly—cheaply. Tarvia penetrates deeply into the road-bed and effectively binds the aggregate. It holds the stone or gravel firmly exposed on the surface, thus providing a smooth, easy-riding, lastingly non-skid road.

An experienced Tarvia field man will gladly suggest simple, inexpensive repair and maintenance methods that will protect your investment in existing roads. The uniformity and dependability of Tarvia plus the intelligent supervision of the Tarvia field man will assure consistently satisfactory results. 'Phone, wire or write our nearest office.

For list of Booklets giving details on maintenance see pages 51 and 52

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AN ECONOMY HIGHWAY

The above illustration is an example of an old gravel street which was scarified, re-shaped, covered with a thin wearing course of crushed stone and given a surface treatment with asphalt, transforming the rough and dusty street into a smooth, safe and beautiful highway. Such reconditioning can usually be done at not over 30 cents per square yard, or $3,500 per mile of 18 foot road.

IN accord with President Roosevelt's dictum, "Do First Things First", The Asphalt Institute urges for a sound highway program four basic requirements in the following order:

FIRST. Protect public credit by providing revenues to pay principal and interest as due.

SECOND. Preserve the investment in highways by thorough maintenance.

THIRD. Improve those highways where failure to improve is more costly than the improvement contemplated.

FOURTH. Provide new construction where it shows adequate return for the outlay.

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NEW YORK, N. Y.

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Diesel Power Hydraulic Control 6-Speed Drive

"77" Motor Graders steal every show...

Build a Motor Grader with greater power—better traction—wider speed range—increased ease of control! That was the order given Austin-Western engineers.

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EXTRA-WIDE FRONT TREAD Improved resistance to side-draft, added steering stability and easier handling are secured through the use of a new front axle with wider tread. In light ditch work, the inside wheel runs on the firm road and maintains perfect tracking with the drive wheels.

Write for the new bulletin completely describing these and many other features. The Austin-Western Road Machinery Co. Home office 400 North Michigan Avenue. Branches in principal cities.

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ROAD ROLLERS, CRUSHING & SCREENING PLANTS, SCARIFIERS, SWEEPERS & SPRINKLERS, ROAD GRADERS, ELEVATING GRADERS. MOTOR GRADERS, PLOWS & SCRAPERS, BITUMINOUS DISTRIBUTORS DRAGS, SHOVELS & CRANES, DUMP WAGONS, SNOW PLOWS.

Don't

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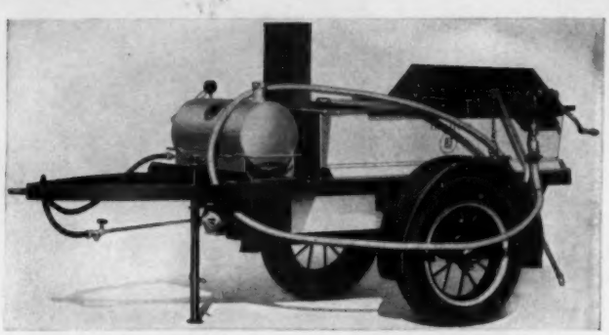

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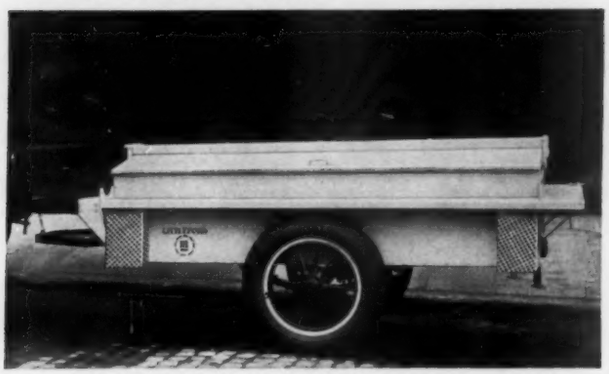
WORN-OUT equipment costs money. Every time there is a break-down, the result is delay—and delay means money. That's when new equipment helps you keep within your appropriation.

Tar Kettles don't last forever; neither do tool boxes, paving tools or other maintenance outfits. Replacement must be made; but, there is no need to make a large outlay for new equipment. Take care of the good equipment you have and replace the worn-out pieces that cost you money to operate.

Keep your highway department operating on an efficient basis; re-equip with new Littleford outfits purchased at the lowest prices in the history of Littleford Bros. Write for a copy of our Road Equipment Catalog and select the outfits you need.

Stop loss and theft of tools by keeping them in the Littleford HanDeeBox. It is made entirely of stee.. One lock securely fastens both covers. There are no padlocks. The City of Cincinnati uses a fleet of twenty-two HanDeeBoxes.



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with the Fast, Inexpensive Barber-Greene System

1. Old road is scarified and the material is windrowed.

2. B-G Plant moves down road under its own power—picks up material — screens it — crushes oversize — retains or discharges percentage of fines desired—discharges properly sized material into windrow behind machine.

3. Windrow is spread across road, and operation is complete.

OLD gravel roads can be brought up-to-date for a negligible cost with the Barber-Greene Portable Screening and Crushing Plant.

The Plant consists of a Barber-Greene Model 62 Self-feeding Bucket Loader with a double deck vibrating screen, and a portable Barber-Greene crushing unit. The Loader tows the Crusher.

The 10' wide spiral pick-up on the Loader gathers the windrowed material into the buckets. A floating scraper immediately behind the spirals makes the pick-up absolutely clean. The material is elevated and discharged onto the upper deck of the screen. The oversize passes over the screen and down to the crusher. The lower screen can be veiled, in which case all of the material passing through the top screen is discharged into the rear windrow. If left partially or entirely unveiled, the fines passing through the lower deck are discharged onto the long cross conveyor—and conveyed to the road side or truck.

The oversize is crushed, conveyed to the spiral pick-up and re-run through the plant. The entire plant requires but one operator.

NOTE TO GRAVEL PRODUCERS: This same plant with a conveyor in the rear instead of the long chute is ideal for obtaining sand and gravel from local sources.

Complete information on request. No obligation.

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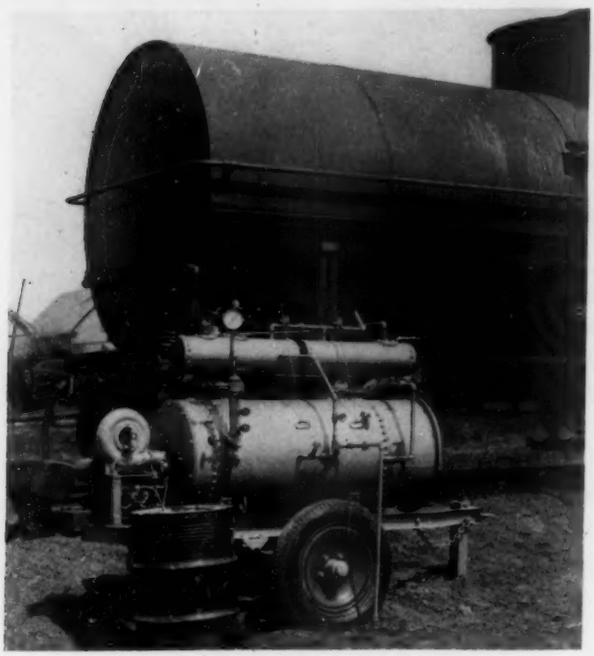

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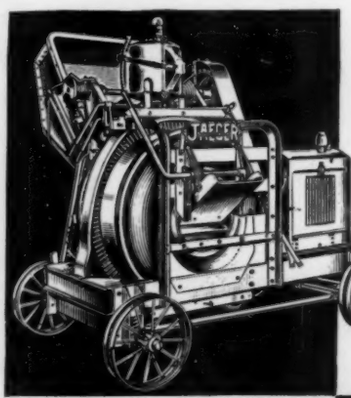

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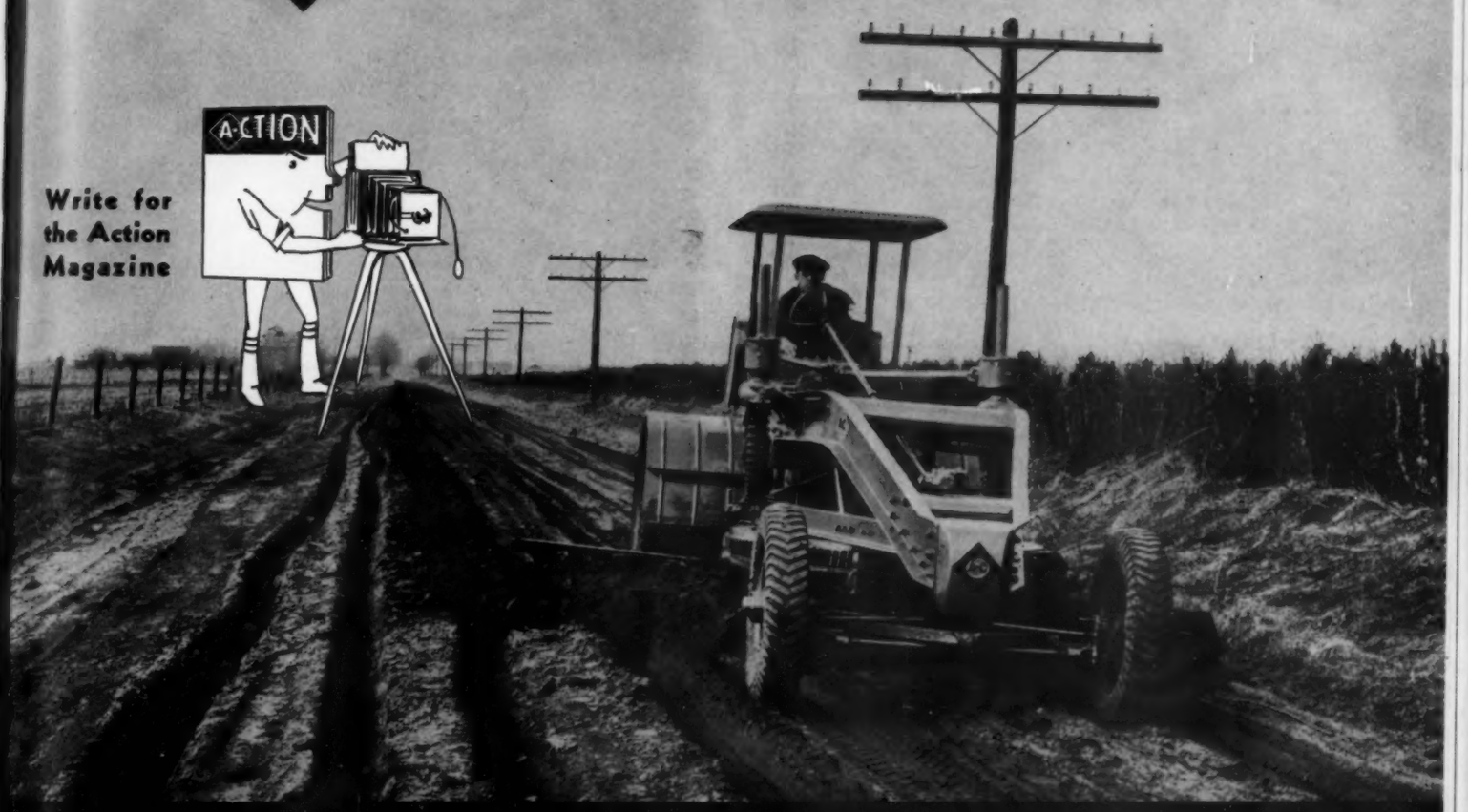

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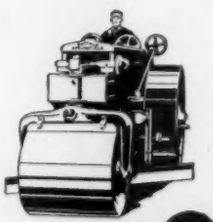

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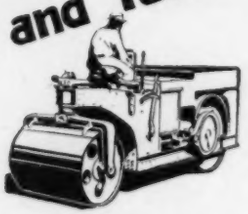

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Practical Details of Concrete Construction

By William E. Barker
Highway Engineer, Portland Cement Association

Colored concrete sidewalk with design conforming to architectural treatment of building

X—Coloring of Concrete

THE coloring of concrete may be accomplished through use of any of several methods: integrally mixed pigments; dusted-on surface finish; colored facings; colored aggregates, and staining with metallic salt solutions. These offer a wide range of colors and surface effects for exposed concrete.

Concrete Quality. The quality of concrete which is used with any of these methods is an important consideration. This is especially true in monolithic buildings, driveways, walks, traffic markers and similar exposed structures. For such construction, not more than 5 gallons of total mixing water per sack of cement should be used. This is usually obtained with a mix of 1-1¾-2¼, using ¾-inch maximum size aggregate for one-course monolithic construction; a 1-1-1½ mix, using ⅜-inch maximum size aggregate as in floor toppings; and a 1-2 mix, using No. 8 maximum size aggregate for faced products.

The quality and grading of the aggregate used is important also. The aggregate should be durable and well graded. Fine material and sand passing a 50-mesh sieve is usually limited to not over 15 per cent because of the additional fine material that is added to the mix by the pigment. Excessive fine material in a mix which is to be finished by steel trowelling is undesirable.

Pigments. A satisfactory pigment for use in integral mixtures, dusted-on finish and colored facing should be sun-fast, produce intense color, and be chemically inert. Commercially pure metallic oxide pigments, either natural or synthetic, fulfill these requirements satisfactorily. Natural metallic oxides which come direct from the mines, while generally somewhat cheaper per pound, usually require a greater amount to produce the same intensity of color than the synthetic pigment. Quite frequently it will be found that the higher priced synthetic pigment prepared especially for use with cement actually produces the desired results at a lower cost than the cheaper natural oxides. To increase their coloring power, the pigments are generally ground to pass a 300-mesh sieve.

Amount of Pigment. Primarily the color produced in the concrete is determined by the proportion of the pigment to the cement, being little affected by the amount of aggregate used within the range of usable mixes. For this reason, the weight of the mineral pigment to be used per sack of cement is that usually specified. Generally, 3 to 6 pounds of the dark pigments and 5 to 9 pounds of the light pigments produce the desired color. Pigments may safely be used in amounts not exceeding 10 per cent of the weight of cement, or 9 pounds per sack of cement.

In determining the amount of pigment to be used, sample slabs are usually made with the mix and the materials to be used on the job, using 2 or 3 different amounts of color in different slabs. After curing these sample slabs in the usual manner, they are allowed to dry and the color proportion to give the desired effect selected for the job.

For uniform integrally mixed colored concrete of high quality, the pigments are usually mixed with the dry cement in a color mixer or factory-prepared colored cement is used.

Placing. To reduce the cost, colored concrete is usually placed in sections 1 or 2 inches thick, as either a facing or a topping for the plain concrete. When placed as a topping, methods regularly used for similar plain concrete construction are satisfactory. The regular 2-course method, where the topping mixture is placed on the hardened base after construction work has been completed, is particularly suitable for interior floor construction; and the 2-course monolithic method where the colored topping is placed before the base course has hardened is particularly suitable for walls, walks, driveways and similar structures which are finished in one operation. Dusted-on mixtures consisting of mineral color, portland cement and coarse, sharp sand may be used on light-duty floors and walks. The dusted-on mixture is placed dry, about ⅛-inch thick, on the unhardened base and floated into the concrete.

Finishing and curing operations are the same for each of these types of construction. Usually the final trowelling is delayed somewhat to produce a denser and brighter surface, and moist curing is continued from 5 to 7 days after placing. The use of watertight curing paper is recommended for important work. Covering with damp sand and ponding are also methods used in curing this type of surface. It is very important that the curing operation be continued for the period mentioned to produce a hard, durable surface.

Colored Aggregates. The use of colored aggregates with colored cement and exposing the aggregate by grinding the surface also affords a wide range of pleasing color effects. Cast stone and terrazzo floors are familiar examples of this method. Crushed marbles and granites are the aggregates generally used because of their durability and ability to take a polish.

Chemical Stains for Concrete. The staining preparations which have been used satisfactorily for concrete consist of slightly acid solutions of metallic salts. When these solutions are painted or wiped on the concrete surface, they react chemically and form insoluble colored metallic precipitates on the surface. Some of these stains are also incorporated with hardeners, resulting in the formation of metallic stearates. This method of coloring concrete is used principally for staining floors and walls. Satisfactory colors can be obtained economically with these chemical stains ranging from a very light cream to a dark reddish brown and also various shades of green. It can be expected that additions to this color range will result in increased demand for this type of treatment, which is comparatively inexpensive.

In addition, cement and water paints consisting of metallic oxides, cement and fine aggregate; stains regularly used for wood surfaces; and oil paints especially developed for concrete surfaces offer a wide choice in decorative treatment for concrete walls. Such treatments, however, require the usual maintenance for painted surfaces.

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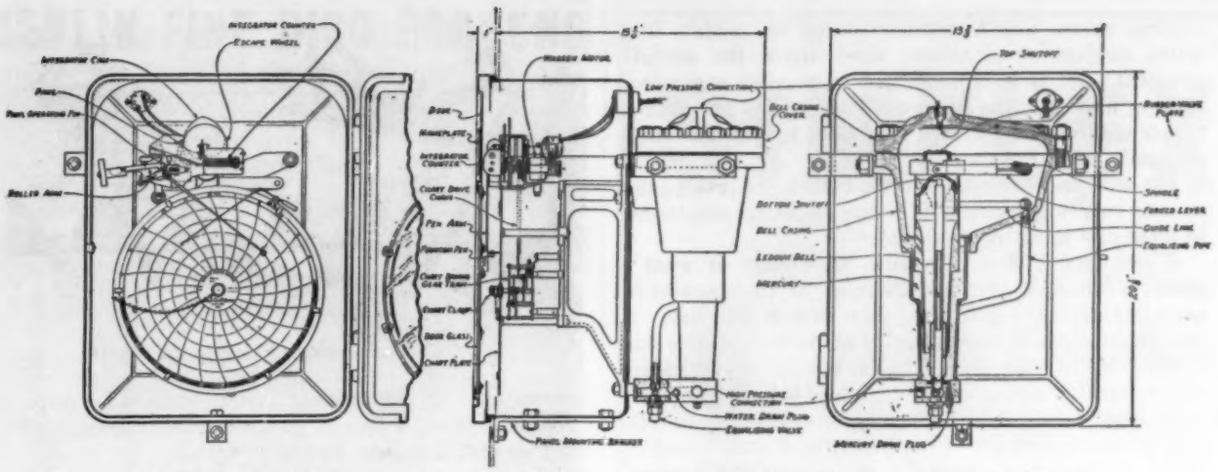


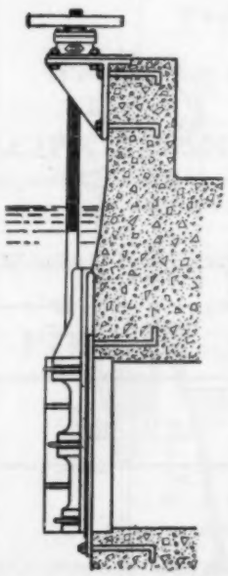
Section through flow mechanism of Bailey Ledoux Bell operated Register for Recording Meter

Mechanical Equipment in Sewage Treatment Works

By A. Prescott Folwell
Editor, PUBLIC WORKS

XI—General Construction and Operating Equipment

A GREAT variety of miscellaneous appliances are used and useful in treatment plants, both in construction and in operation. Among the former are valves and gates, weirs and meters, conveyors and elevators. Among the latter are included hoes, squeegees, and other appliances for cleaning channels and tank walls, Imhoff slots, etc.; for removing grease and scum, for measuring sludge and scum; and laboratory equipment such as Imhoff glasses, BOD bottles, comparators for pH and chlorine, thermometers, turbidity rods, etc.



Sluice gate with bench stand on wall bracket

Construction Equipment

Values and Gates. These are used for controlling flow into and out of tanks, filters, etc., through pipes and in open channels, and through walls. As the pressure seldom exceeds ten or fifteen pounds, the lightest pipe line valves that can resist the ordinary strain and wear due to turning on and off will generally suffice. Those used for gas lines are generally heavy enough. As lead joints subject them to less strain than flange joints they are generally preferable, except where they are exposed, as in pipe galleries, and it may be desirable later to remove them, as for repairs. Standard valves obtainable from any valve manufacturer are suitable.

For use in openings through walls, shear gates and sluice gates are cheaper and more convenient. Shear gates are operated by direct pull or push, revolving about a pin at one side of the opening. Sluice gates travel vertically, being operated by one or two screw stems. The former (which are also used at the ends of pipe lines) are used in sizes up to about 18 in. diameter; the latter up to 8 ft. or more, either circular or rectangular. Sluice gates may have either rising stem or self-contained; the former rising with the gate, the latter threaded through a nut forming part of the gate. As the gate and the lower part of the stem are generally immersed in sewage or sludge, the rising stem with the nut above the sewage is preferable.

Shear Gate

For operating the sluice gate, a floor stand (with the hand wheel waist high) or a bench stand (with the hand wheel 6 or 8 in. above the floor) is needed. This may be set on the tank roof, or on a special beam or bracket above the gate; or an iron wall bracket may be fastened to the face of the wall. The threads of rising stems may be protected from knocks and the weather by a stem cover—a pipe with the upper end closed.

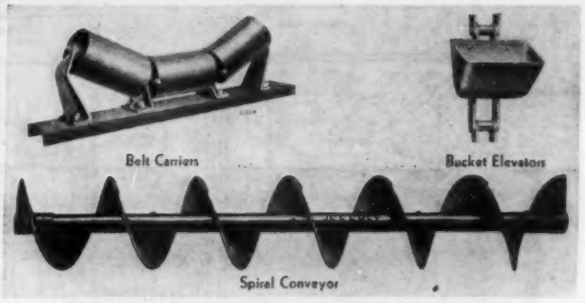
Where the pressure on the gate is on one side only, a plain gate without wedges is usually tight enough (placed, of course, so the pressure holds it against the seat); but if pressure may come on either side (as in an opening between two tanks) the wedge type should be used.

Flap valves are sometimes placed on outlets into water subject to occasional rises above the outfall gradient; but if it is important to prevent any water leaking back into the plant a sluice gate is preferable, supplemented perhaps by a flap valve to function automatically until the gate is closed.

For horizontal openings in the bottoms of tanks, plug or mud valves operated with rising stems are obtainable in sizes of 4 to 12 inches or more.

Weirs and Meters. Definite knowledge of what a plant is doing requires knowledge of the amount of sewage entering and leaving each unit at all times. A continuous record automatically made is desirable and is obtained in some large plants; but for a small plant the apparatus necessary for giving this is generally considered to require too large a percentage of the total cost to be warranted. For the latter a non-recording meter or weir may be used and the reading recorded by the attendant at regular intervals of from once to twelve times a day. Either recording or non-recording meter and weir indicators can be installed at any desired distance, so that the flows at all parts of the plant can be indicated in one central office.

Weirs are generally made to order locally, of a brass, bronze or other metal plate say ⅜ inch thick, with rectangular, cippoletti or triangular opening; with knife edges beveled on the outside. The deeper the flow, the more accurate the reading, but also the greater the loss of head. The depth on the weir should be at least 0.5 inch at time of minimum flow, and preferably twice this. The greatest pains should be taken to set and maintain the crest of the weir absolutely level and permanent in elevation. If the weir is at the outlet of a pipe or channel giving a flow of greater velocity than 0.5 foot per second, a stilling box is desirable.

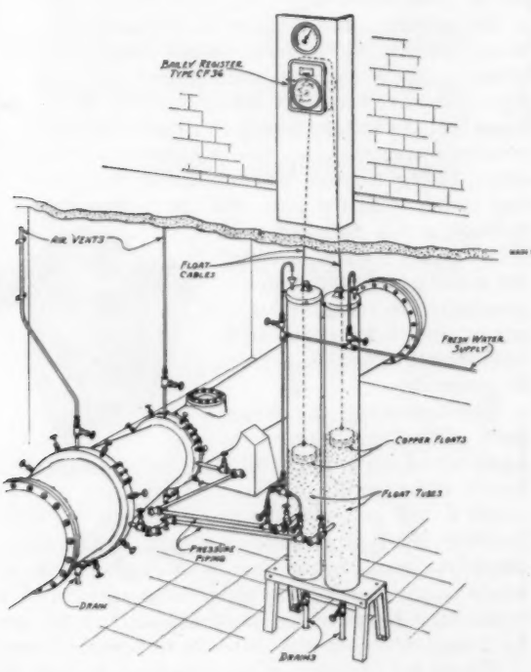


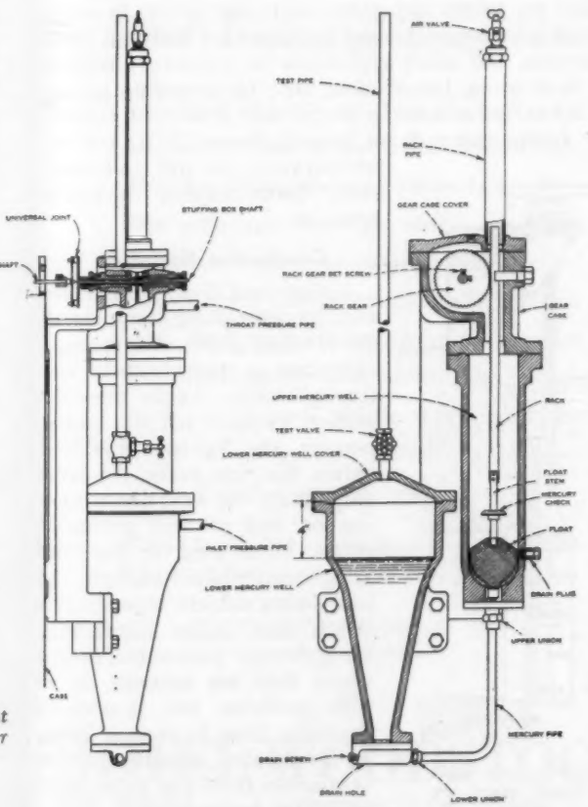
Mechanical details of various conveyors

To measure and indicate the head, and record it if desired, instruments can be obtained from the Simplex Valve & Meter Co., the Bristol Co., W. & L. E. Gurley, The Brown Instrument Co., and others.

Where dosing tanks are used, as in connection with sprinkling filters, a knowledge of the quantity discharged and the frequency of discharges gives the desired information. Any one of several designs of counters can be used for recording the number of discharges; and the time of each, also, if desired.

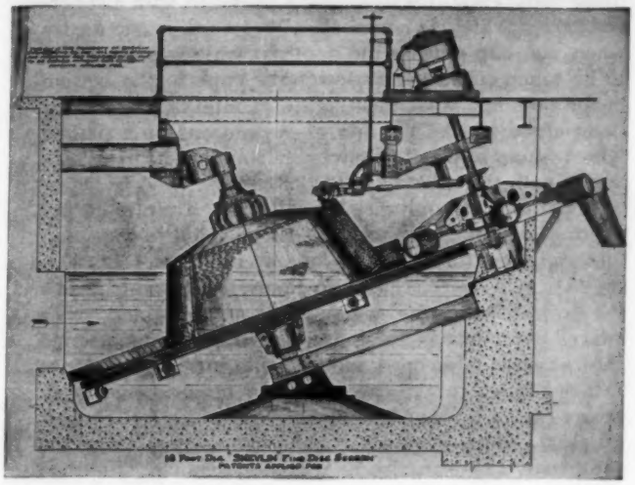
For measuring flow in pipes, the meters commonly employed are those based on the venturi principle. Different manufacturers use slightly different details in the meter itself, but most of the differences are in the indicating and registering devices, using floats, rack





Above—Bailey float-operated type sewage meter. At right —Builders Iron Foundry gear-operated recording register

SHEVLIN FINE DISC SCREENS



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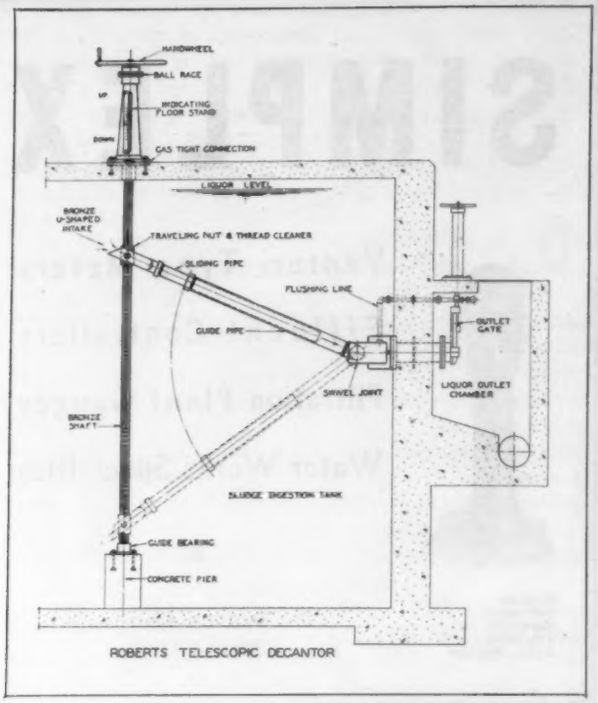


ROBERTS TELESCOPIC DECANTOR

and gear, the Ledoux bell, etc. Among the makers of these meters and devices are the Simplex Valve & Meter Co., Bailey Meter Co., Builders Iron Foundry, Republic Meter Co., Brown Instrument Co. These meters are furnished in all sizes, from pipes of 4 inches diameter to the Conowingo conduit 41 x 44 feet. The venturi meters are used for measuring air also, as for activated sludge plants. The Brown flow meter differs from the true venturi in that an orifice plate is substituted for the venturi throat. In the electric flow meter the inductance bridge principle is used to secure long-distance transmission of the differential pressure in the meter.

Conveyors. Where considerable quantities of non-fluid materials such as dried sludge, screenings, lime, paper pulp, etc., have to be handled regularly in a plant, different forms of conveyors and elevators are often convenient and even economical. Those used include belt conveyors, and spiral and flight conveyors working in troughs, for moving horizontally and at rather flat slopes; and bucket elevators for lifting materials vertically. Belt conveyors are generally used for long-distance transportation; spiral conveyors for short distances only; scraper flight conveyors (generally the least expensive) where troughs and flights are not subject to excessive abrasion or corrosion.

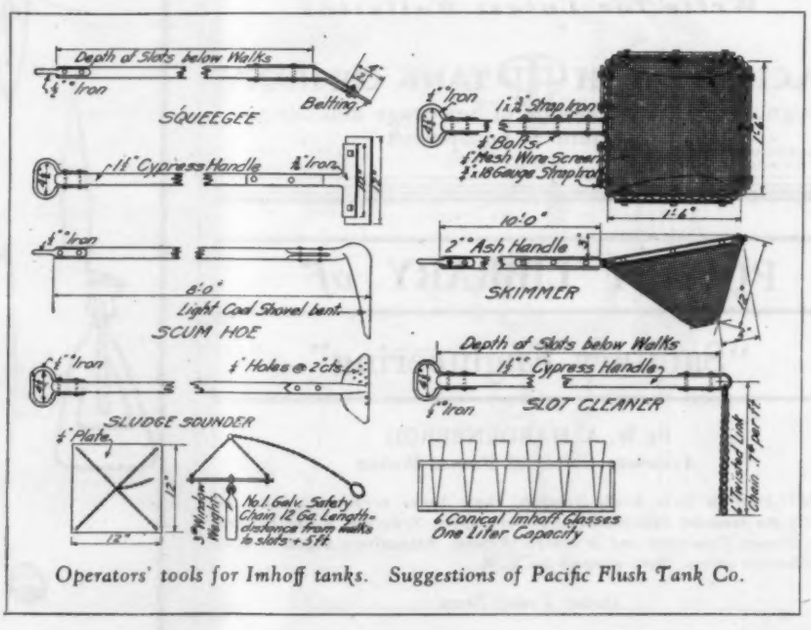
Collecting samples from sewage or sludge tanks which shall be composites representative of all depths and of changing conditions throughout a period of, say, 24 hours is the purpose of the "Geco" automatic sampler. This consists of a frame containing two endless chains which carry three sampling cups; each of which cups is provided with a spherical cover which is automatically raised momentarily when that cup reaches the depth at which its sample is to be taken. The chains lower the cups to the bottom of the tank and raise them again at intervals which are determined by the number of revolutions of a paddle wheel immersed in the sewage channel, which in turn varies with the velocity of the sewage.

A permanent appliance for collecting samples at any depth of a tank (especially useful for sludge digestion tanks) is the "telescopic decantor" of the Roberts Filter Mfg. Co. A pipe through the wall at a point below the lowest operating water level is connected by a swivel joint, just inside the wall, with a swinging pipe into which is telescoped another pipe carrying a bronze intake; which intake can be raised or lowered to any desired level by its engagement with a vertical threaded shaft, which is revolved by a hand wheel above the tank roof. This can also be used for removing liquified scum.

Temperature of sewage and sludge at various places and times is an important item of operation control. This may be obtained by inserting a thermometer when and where desired; but it is preferable to install a permanent recording thermometer at the more important points, for often the importance of knowing the temperature is learned only when it is too late to take it. The bulb and pressure gauge may be connected by tubing for considerable distances, as from tank to office. Tubing up to 200 feet, for example, can be used with Brown recording thermometers. Bristol Co., Taylor Instrument Co. and others furnish thermometers also.

Note: Laboratory equipment and gas masks will be dealt with in the May issue, including lists of equipment recommended for sewage treatment laboratories of two of the states.

In addition, the May installment of this series of articles—the twelfth and last—will describe equipment of various kinds which has been made available to plant operators since the appearance of the article dealing with that particular class of equipment.



Operators' tools for Imhoff tanks. Suggestions of Pacific Flush Tank Co.

Accuracy Is Essential in Making Residual Chlorine Determinations

The test for residual chlorine in treated water is, with the exception of bacteriological analysis, the most important criterion of effective chlorination. In New York State, the usual method of making this determination is the so-called "orthotolidine test." Unless this examination is properly made and correctly interpreted, false results are obtained. This was forcefully illustrated recently in connection with the chlorination of an upstate city water supply.

This supply is obtained from an impounding reservoir near the city and is chlorinated by means of equipment which automatically varies the chlorine dosage with the changes in the rate of flow of water through the pipe line. The records of operation of the chlorinator indicated that a residual of free chlorine was being maintained in the treated water. Samples collected from representative taps in various sections of the city, however, were found to have high bacterial counts and to contain *B. coli*.

An investigation made by an engineer of the Division of Sanitation of the State Department of Health showed that the operator had been conscientious in making the tests for residual chlorine but, due to incorrect methods, the determinations indicated a much higher residual than was actually present. The operator had collected a sample of water daily from a tap a short distance below the point of application of the chlorine, and immediately added the orthotolidine solution. The proper procedure is to wait ten minutes before adding the solution, in order to allow for absorption of chlorine by organic matter, and then to let the sample stand five minutes before making the reading. On the day of the inspection the operator's reading gave a residual of 0.4 p.p.m. but a determination made by the engineer indicated that the true residual was but 0.1 p.p.m., and that the water was not being effectively chlorinated.

Following this investigation the amount of chlorine was increased and the water was found to have low bacterial counts and to be free from *B. coli*.

Public Health Work for Unemployed

Some Georgia towns and counties have made considerable progress in providing work on malaria drainage for the unemployed. One county is not only using the unemployed for malaria drainage but also for sanitary privy construction. Records compiled by the Division of Sanitary Engineering of that state show that twenty-three towns, cities and counties gave employment to a maximum of 1,044 persons at one time. Considering that employees are alternated so as to divide the work among as many as possible, it can be seen that a number much greater than this is provided with work.

Thomas county, under a loan from the Reconstruction Finance Corporation, has crews distributed at various places digging ditches for malaria control and constructing sanitary privies.

It seems rather simple for a county to borrow money from the Reconstruction Finance Corporation for this type of work, because every cent goes for labor. There is no material to be purchased in connection with the drainage, and for the sanitary privies the municipalities or home owners furnish the material. In such towns and counties, charitable organizations are given considerable relief from a strain of caring for the destitute, and economic conditions have been greatly improved. It is to be regretted that more counties are not taking advantage of loans for unemployment relief.

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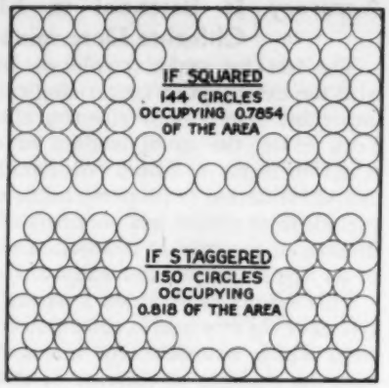

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This means that you are getting only about half to three-fourths of the full efficiency of your filter—the most expensive unit of your entire plant.

Another point: To produce these sprays requires at least five to eight feet head; and this may make all the difference between having to pump or not having to.

It is possible to distribute the sewage at a perfectly uniform rate over the *entire* bed, and with only two or three feet loss of head. This is done by the

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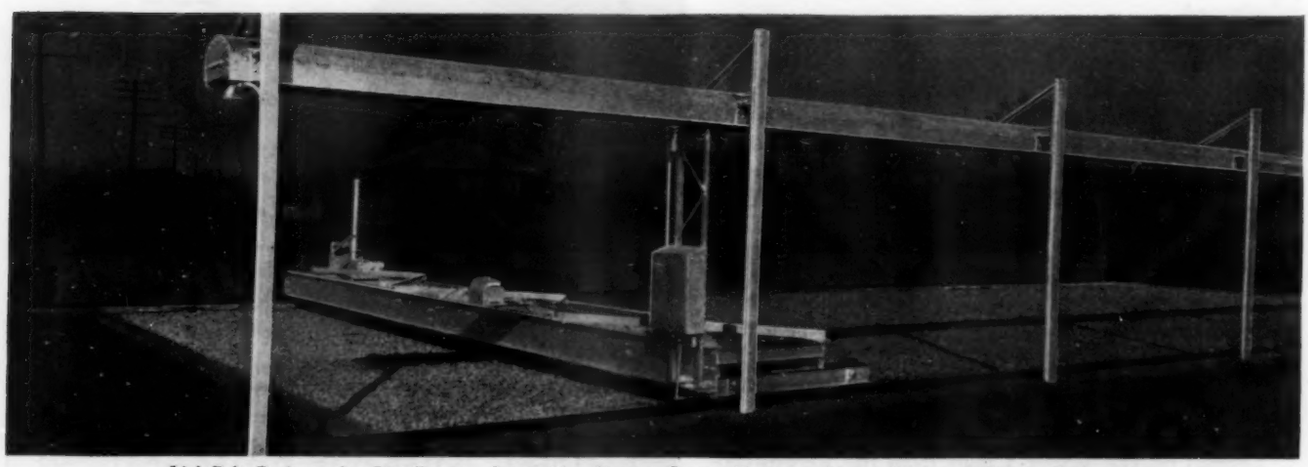
which consists of a trough carried back and forth from end to end of the bed, over which spills the sewage brought to it by gravity; V-notches, spreader plates and a leveling angle insuring uniformity of distribution.



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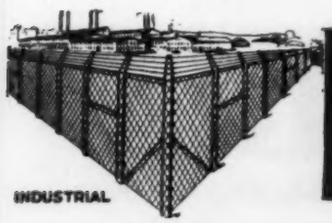

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Economics of Maintenance and Reconstruction

By C. N. Conner

(Continued from page 26)

that little or no money should be spent for constructing those local roads which carry less than, let us say, 50 vehicles per day.

The transportation survey recently completed in Michigan by the Bureau of Public Roads and the State Highway Department confirms this and shows that the Michigan State highway system of 7,700 miles of trunk line roads serves an average daily traffic of 1,144 vehicles; the 17,175 miles of county roads serve an average daily traffic of 190 vehicles; and the 60,214 miles of purely local roads serve an average of 22 vehicles a day.

From this survey it is clear that the mileage of roads which serve 1,000 or more vehicles a day is small, while those which serve less than 50 vehicles daily is large.

Thomas MacDonald, Chief of the Bureau of Public Roads, reviewing this report, concludes the use of such light-traffic roads in any part of the United States is so slight as to neither require nor warrant any surface improvement other than that necessary to carry the farm traffic. The only work which furnishes this type of surface improvement at lowest total cost is maintenance; the cost of new construction cannot be justified by the traffic.

Stated in other words, we have in the United States some 2,000,000 miles of unimproved roads on which only simple improvement in the form of low-cost maintenance is needed and can be justified.

The Cost of Poor Roads

The dollar and cents justification of expenditures on any type of road is found when such expenditures enable it to render satisfactory service to traffic economically. But in a wider sense, the true value of all road work includes also the provision it makes for needed employment, and those intangible benefits which result in community growth, self-respect and happiness. The latter are difficult to evaluate, but that they have a real value cannot be denied.

Through traffic surveys and studies, coupled with demonstrated figures of cost of automobile traffic, Michigan has determined the value of maintenance. This has been discussed by A. C. Benkelman, research engineer of the Michigan State Highway Department, in a recent unpublished report. In reality, his report goes still further and shows the costs of unpaved and paved road surfaces for various densities of traffic, based on the actual maintenance cost figures of the Michigan Highway Department.

Maintenance and Vehicle Costs for Gravel

From Michigan records covering the maintenance of 3,000 miles of gravel road, on which the average *annual* construction cost per mile was $506, the following figures are established:

T	C	M	Cv	Ct	S
50	$506	$640	$1,049	$2,195	$136
100	506	730	2,098	3,334	273
250	506	870	5,245	6,621	682
500	506	1000	10,490	11,996	1,365
750	506	1105	15,735	17,346	2,134

T is the traffic in vehicles per day.
C is the annual construction cost, Michigan figures.
M is the maintenance cost per year.
Cv is the operating cost at 5¾ cents per mile for the volume of daily traffic for 365 days.
Ct is the sum of C, M and Cv.
S is the saving in dollars per mile per year for a paved surface over an intermediate surface due to lower automobile travel costs.

The most interesting item in the table, however, is the large annual maintenance cost on gravel surfaces. This increases rapidly with the volume of traffic and for 3,000 vehicles per day the records show an annual maintenance cost of $1,710 per mile of road. Of course, for a traffic as heavy as this, a pavement would be far more economical. Even in the lower traffic figures, there is no doubt that a surface treatment would greatly reduce maintenance costs.

In establishing these figures, the cost of vehicle operation was placed at 5¾ cents per mile for gravel and 5 cents a mile for pavement. Prof. Agg's data, as published in bulletins of the Iowa State Experimental Station, show generally a difference of 1 cent a mile in cost of automobile travel for intermediate as compared to high type road surfaces. [Ed. Note—It is believed that ½ cent per mile well represents the present savings per car which may be credited to road improvement.]

Based on these Michigan figures of first cost, maintenance and traffic operating cost, computations show that a pavement 2½ times as high in first cost and three times as high in annual cost as the gravel, is economical for any traffic in excess of 190 vehicles per day. An allowance of ½ cent a mile for vehicle operation saving, instead of the ¾ cent used, would modify these figures somewhat.

Value of Figures

These figures are chiefly of value in showing when a highway has reached an uneconomical stage and should be replaced with a higher type in the interests of economy. Thus, the gravel road carrying over about 100 vehicles per day, on this basis, should be carried along the next step in stage construction, probably by surface treatment, or, perhaps, if the traffic amounts to 500 or more vehicles, a mixed-in-place surface may be economical.

A complicated formula for finding the annual road cost R has been evolved by the Michigan Department and is reported by Mr. Benkelman:

$$R = M + EA\left(\frac{1}{(Sn} + h\right) + E'A\left(\frac{1}{(Sn'} + i\right)$$

Where
M=Maintenance cost per year from records.
A=Cost of construction.
i=Interest rate.
E=Expenditure for periodic maintenance in % of A every n years.
E'=Expenditure for periodic maintenance in % of A every n' years.
Sn=Amount of annuity of $1 for n years.
Sn'=Amount of annuity of $1 for n' years.

E and E' and Sn and Sn' are employed where different limits of life are assumed for different parts of the pavement. For instance, if a life of 25 years is assumed for the surfacing, which amounts to 60% of the total cost; and a life of 50 years for the grading, draining and other items,

E =60% N =25 years
E'=40% N'=50 years

Knowing the actual costs of maintenance and of construction, any engineer can compute the volume of traffic which will justify the construction of the next higher step in stage construction.

The Los Angeles North Outfall Sewer

In the article in our February issue entitled "Completing the Longest Continuous Gravity Sewer in the United States," it is stated that this is "a continuous gravity line about 80 miles long." The author writes us that, through a typing error which he failed to detect, a mistake was made in this mileage figure, which should have been 60 miles.

Improved Highway Construction and Maintenance Equipment

A New Bituminous Mixer

The Kwik-Mix Division of the National Equipment Corporation has recently developed a new bituminous mixer. It is built in two sizes—6 to 8 cubic feet and 10 to 12 cubic feet. Specially designed, adjustable, manganese "saw-tooth" blades, with a criss-cross mixing action, accomplish a thorough and speedy coating of the material with a minimum of bitumen. A detachable heater is conveniently located at the end of the machine away from the engine, for safety and efficiency.

The indirect application of heat, by means of a shell around the drum, causes even heat; therefore, the material is not burned, neither does it become "balled." A clean drum at all times insures a full batch.

These machines permit economical placing of cold or hot patch material on location, for bituminous roads. They are also used for centralized plant operation, or for surfacing projects.

The Allis-Chalmers Speed Patrol

The A-C Speed Patrol is designed for faster and more economical maintenance. Outstanding features include: Ball and socket wear take-up joints on the complete mold-board assembly; 95-inch blade base (distance from front axle to moldboard), since a long blade base is essential for smooth maintaining; full power control—42 horsepower engine; four speeds forward—2 1-3, 3 1-3, 5 and 10 miles per hour with a normal maintenance speed of 5 miles per hour; bolted construction throughout with fine threads and high nuts; 64-inch full circle; blade pressure 7,240 pounds without scarifier; dual brakes; 52-gallon gasoline capacity.

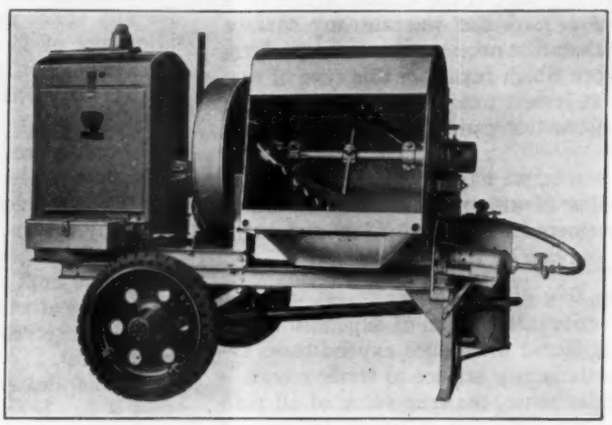
It is built in its entirety by Allis-Chalmers, permitting a new low sales price. It meets requirements of contractors, state and county highway departments. It can be equipped with lights, starter, closed cab and other accessories.

Reducing Haulage Costs

The Grico four-wheel drive unit is designed to be fitted to small trucks, thereby increasing their carrying capacity, and reducing haulage costs, investment and maintenance. It is manufactured by the Gear Grinding Machine Co., Detroit, Mich.

The spring suspension results in extreme flexibility in distributing the load to all the driving wheels equally—even without great inequalities of road surface, and without body tilt or sway; an 18 in. hole means nothing to this job. In addition, this flexible spring suspension reduces road impact on the body and chassis, and keeps repair costs down.

Four-Wheel Grico Drive Unit on International Truck



The New Kwik-Mix Bituminous Mixer

New Lorain 40-30 Crawler Shovel and Crane

The Universal Crane Company, Lorain, Ohio, announces a new line of crawler shovel and crane equipment ranging from ¾-½-⅜ yd., known as the Lorain 40 and 30. Through balanced design, these units, it is claimed, develop the greatest capacities per pound of weight ever attained in excavating equipment. The working weight of the Lorain 40 as a ¾ yd. shovel is approximately 30,000 lbs. and of the Lorain 30 as a ½ yd. shovel, approximately 23,000 lbs.

The dippers on the units, and their crane ratings conform to the standards of the Shovel and Crane Manufacturers' Association.

Balanced design is based on the theory that the shovel or crane capacity is dependent upon stability and strength rather than weight. In this new design the machinery frame is tilted toward the rear, thus all the turntable machinery has been grouped far back of the center pin so that it does double duty—it performs its operating functions, yet utilizes its own weight to counterbalance loads lifted.

The Rex Automotive Road Pump

Enough water and fast enough for any 27-E Paver, plus sprinkling, plus curing, is claimed by the Chain Belt Company for their Rex road pump. The Rex road pump will deliver 80 gallons at 500 lbs. pressure or 125 gallons at 320 lbs. pressure. Tests show that the pump can handle successfully 1150 feet elevation or 12 miles across country.

With the Rex automotive design, the pump and reduction case are lubricated just like automobile engines.

Above: The new Lorain 40-30 Crawler Shovel and Crane. At left, the Allis-Chalmers Speed Patrol for Road Maintenance.

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★ *It is a good practice to check this list regularly because descriptions of new bulletins are always being added.*

Construction Materials and Equipment

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

11. A very complete 24 page booklet covering all five sizes and types of Iroquois Asphalt Mixing Plants which are particularly adapted to meet the needs of municipalities and contractors, providing maximum output at minimum cost. Barber Asphalt Co., 1600 Arch St., Philadelphia, Pa.

Bituminus Paving Machines

25. 32 Miles of Bituminous Roads in 256 Machine Hours and similar feats are described in a 16 page booklet (No. BPF) on Bituminous Road Construction with the Barber-Greene Bituminous Paver and Finisher, issued by the Barber-Greene Co., 635 West Park Ave., Aurora, Ill.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills." A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Galion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

77. The new "Speed Patrol," so named because of its ability to speed up maintenance work, is illustrated and described in two new booklets just issued by the Tractor Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. A new line of heavy duty motor trucks and tractors for dump and commercial hauling is described in literature recently issued by the Sterling Motor Truck Co., Milwaukee, Wis.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the MacMillan Petroleum Corp., El Dorado, Arkansas.

114. Complete information concerning Alabama Asphaltic Limestone will be sent promptly on request to the Alabama Asphaltic Limestone Co., Liberty National Bldg., Birmingham, Ala.

Road Machinery

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

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The Buffalo-Springfield Roller Company, Springfield, Ohio.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Gallon Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

144. Complete information including operating ranges of General Excavators is given in Bulletin No. 3210 recently prepared by The General Excavator Co., 365 Rose St., Marion, Ohio.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" transits and levels are described and illustrated in a 64-page booklet. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Tractors

170. Everything you want to know about the Model L Allis-Chalmers Tractor is contained in a new 30 page illustrated booklet issued by the Tractor Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Road and Street Maintenance

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

201. "Heating Bituminous Materials" is a new booklet dealing with the problems involved in heating bituminous materials shipped in railroad tank cars and contains full data regarding the Cleaver-Brooks equipment for meeting all heating requirements. Published by Cleaver-Brooks Co., 740 No. Plankinton Ave., Milwaukee, Wis.

Distributors

206. Kinney distributors of from 600 to 1,700 gallon tank capacity with heating system and the Kinney jacketed pump having a capacity of over 400 gallons per minute are described in a new catalog just published by the Kinney Mfg. Co., 3529 Washington St., Boston, Mass.

207. Kinney Junior distributors in sizes from 350 to 600 gallons with smaller pumps and engines especially adapted for light trucks are described and illustrated in a new booklet just issued by the Kinney Mfg. Co., 3529 Washington St., Boston, Mass.

208. "Important Message for Those Road Builders Who Want More for Their Money," a new folder on low-cost roads, and three illustrated bulletins covering their line of asphalt, tar and oil distributors will be sent promptly by E. D. Etnyre & Co., Oregon, Ill.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Surface Heaters

220. The "Hotstuff" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the Macmillan Petroleum Corp., El Dorado, Arkansas.

225. "Enduring Pavements and the Evidence." Everyone should have this data book on the use of lake asphalts. Contains 33 illustrations and list of streets and highways in this country paved with Natural Lake Asphalts. Gives yardages and days laid. Issued by the Barber Asphalt Co., 600 Arch St., Philadelphia, Pa.

226. Full details concerning the uses and advantages of Lincolnite Pulverized Petroleum Asphalt, Linco Road Oils, Cutback Asphalt Cement and Penetration Asphalt Cements will be sent free on request by Lincoln Oil Refining Co., Box 251, Robinson, Ill.

227. "Asphalt for Every Purpose, a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

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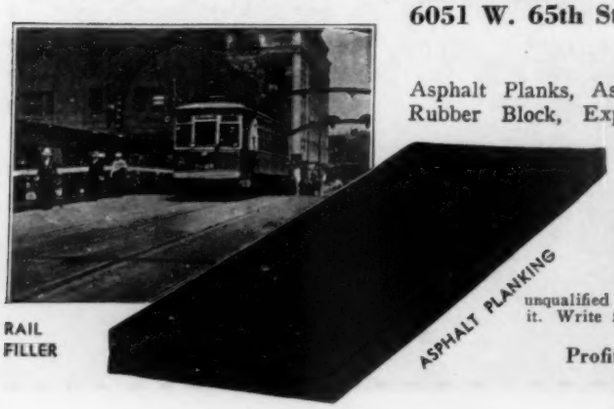


Asphalt Planks, Asphalt Tile, Rail Filler, Rubber Block, Expansion Joints, Asphalt Emulsions, Colored Fillers, Cable Trunking.

Servicised Fibrated Asphalt Plank is giving service in hundreds of first class installations. The pioneer of this line Servicised Planking has the unqualified approval of all who have used it. Write for prices today!

Profitable territories open for distributors

Servicised Felt Reinforced Expansion Joint

In this type of joint reinforced strips of heavy saturated felt are cemented to the core on either side. Joints of this kind are especially serviceable for insert sections in brick and block paving as well as for expansion joint.

Servicised Super Rubber Joint

This sponge rubber product excels in all tests in ageing qualities and resiliency, insuring greater life. Servicised Super Rubber Joint is particularly adapted for sidewalk, curb and gutter, building work, viaducts as well as pavement. The upkeep is reduced to a minimum. Write for prices today!

Boye New Head of Asphalt Institute

At their annual meeting the Board of Directors for Asphalt Institute, representing three-fourths of the major asphalt producers of the United States and Canada, elected B. L. Boye president of the organization to succeed William H. Kershaw of the Texas Company. Mr.

B. L. Boye

Boye, who has been with the Standard Oil Company of New York for 33 years, is now in charge of that company's asphalt and fuel oil activities.

Other officers elected were: Vice Presidents, Leroy M. Law, Shell Petroleum Corp.; A. M. Maxwell, President of the Standard Oil Company of Ohio, and J. A. Blood, Standard Oil Company of California.

W. W. McFarland, President of the Warner-Quinlan Company, was elected secretary, and Herbert Spencer, Standard of New Jersey, was elected treasurer, with W. E. Gilligan of the same company as assistant treasurer. The board named C. W. Bayliss, Barber Asphalt Company, to be chairman of the new executive committee, with J. S. Helm, Standard Oil of New Jersey and Messrs. Boye and McFarland as the other members of that committee. J. E. Pennybacker continues as managing director of Asphalt Institute.

New Jersey Sewage Works Association

The eighteenth annual meeting of this nationally known association was held at Trenton, N. J., March 23 and 24. The attendance was surprisingly good—up, in fact, to pre-depression figures. A number of exhibits showed late developments in sewage treatment apparatus, while interesting and instructive models were set up by such firms as Link-Belt, Row Engineers and Dorr Co. In fact, the exhibits presented quite an education in progress in sewage treatment.

The first day's papers were devoted principally to engineering developments, and the second day to operation. Data on the sewer rental laws in New Jersey was presented by C. A. MacDonald; I. O. Lacy gave a long and interesting paper on the practical data covering sprinkling filters, which was discussed by H. Heukelekian and a number of others. C. G. Wigley opened the afternoon session with a discussion of pollution of bathing waters and the effect on health. Following this was a number of talks on chemical precipitation, with L. L. Hedgepeth, John R. Downes, Wellington Donaldson, and others participating. Dr. Willem Rudolfs compared treatment methods for stale and fresh sewage.

The famous speechless dinner and entertainment was the feature of the evening, with round table discussions before, during and after.

Operational papers on Friday included those on the Collingswood plant, by C. W. Dare; on the new Princeton plant, by I. R. Riker; and on the Freehold plant by W. J. Schiverea. There was also a discussion of the new licensing rules for plant operators and of RFC loans.

Z. E. Sevison: At the first meeting of the newly appointed majority of the Wyoming Highway Commission, it was decided to replace Z. E. Sevison as the head of the department, when his term expires in June. Mr. Sevison has been State Highway Engineer of Wyoming for 16 years, or since the organization of the department in 1917, and for the major part of that time he has been the executive head of the department. He is President of the Western Association of State Highway Officials and for many years has been a member of the executive committee of the American Association of State Highway Officials.

He pioneered the bituminous treatment of gravel and crushed stone roads in the intermountain states and as a result this low-cost type has proven successful for a large territory.

In point of service he will be the oldest highway executive in the country when he retires and will have the unique record of having laid out a complete state highway system and carried it through to a final uniform standard of improvement.

Edward D. Etnyre, president of E. D. Etnyre & Co., Oregon, Ill., died on March 10.

Power Shovels.—Bay City Shovels, Bay City, Mich., has issued a new catalog which contains complete detailed specifications, working range diagrams and illustrations of the new Bay City Model 30 shovel, crane, dragline, skimmer or clamshell.

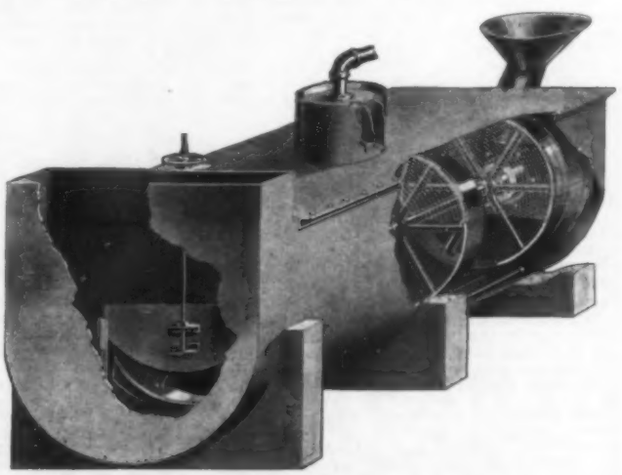
Incinerators. — An interesting and complete 24-page booklet about incinerators has been issued by Decarie Incinerator Corporation. This contains a good deal of information on the problem of municipal refuse, and is well worth a place in the file of any engineer. Sent on request.

Solving the Screenings Disposal Problem

Sewage screenings are largely cellulosic and other organic materials. The cellulose materials, taken by themselves are quite stable and can be disposed of readily in any one of several ways. The problem is, therefore, to treat the remaining organic matter in such a way as to render it and the entire mass inoffensive and non-putrescible.

Research indicates that this can be accomplished very satisfactorily in a digester of the type shown herewith. Tests have shown that the residue from such a digester is a fibrous, non-putrescible, odorless product with an average moisture content of about 85%, which can readily be dried on beds without attracting flies, burned, or spread on the ground without nuisance.

The PFT digester, which is manufactured by the Pacific Flush Tank Co., 4241 Ravenswood Avenue, Chicago, Ill., is fully described in an interesting bulletin which contains much information on this problem. Copies of the bulletin and a complete description of this digester will be sent on request. Data on quantity of screenings recovered from various plants and results of tests are included in the bulletin.



The PFT Screenings Digester

USE THE COUPON ON THE BOTTOM OF PAGE 51

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When you want catalogs describing materials or equipment advertised in PUBLIC WORKS refer to the classified INDUSTRIAL LITERATURE section beginning on page 51 and order by number.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

Snow Removal

Snow Fences

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 400 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

Ferric Chloride

381. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Meters, Sewage and Water

405. Just issued. Every sanitary engineer should have a copy of this new 32 page booklet describing the applications, types and distinctive features of the new Bailey meters for sewage treatment and water supply. Sent promptly. Bailey Meter Co., 1027 Ivanhoe Road, Cleveland, Ohio.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

381. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Treatment

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.

Miscellaneous

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books No. 125, Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Transits and Levels

630. Transits and Levels particularly adapted for City, County and State work are described in a 64-page catalog. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

For Sewage and Water Treatment

"ISCO"

Ferric Chloride

Solution or Crystal

For Sludge Conditioning. Ferric Chloride has been accepted as the most efficient agent from the standpoint of quantity and cost.

For Coagulating Sewage. Ferric Chloride provides an inexpensive and effective method of dealing with plant overloads.

For Water Filtration. Ferric Chloride is an economical and practical coagulant. It gives a quick forming, fast settling floc.

"ISCO"

Chlorinated Lime

Use "Isco" Chlorinated Lime for water and sewage treatment.

No deadly gas danger.

No expensive equipment needed.

No containers to return.

Chlorinated Lime gives best results for sterilizing sewage effluent.

Write for list of articles giving experiences of many plants in the use of FERRIC CHLORIDE

INNIS, SPEIDEN & CO.

117 Liberty Street **New York, N. Y.**

IN EVERY STATE OF THE U. S. A.
IN EVERY PROVINCE OF CANADA

TOTAL

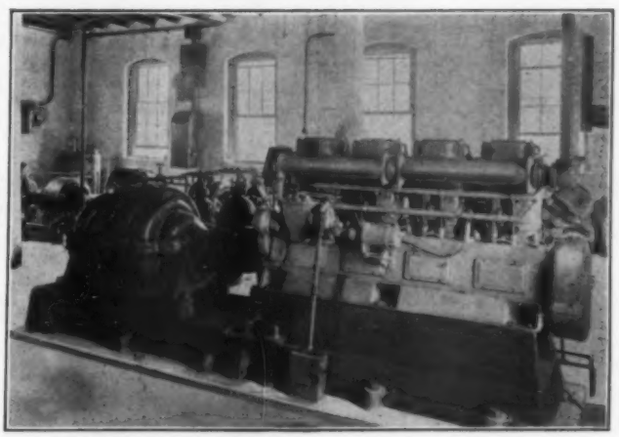
Over 1000 Sterling Engines are serving reliably in emergency.

Sterling High Duty

Sterling — The Engine of Refinement

Internal Combustion Engines

12 to 565 B.H.P.
Gas or gasoline



At Decatur, Ga., GRC—8 cylinder 240 H.P. Sterling engine driving a Dayton-Dowd 8" type CSD, 4 stage centrifugal pump, 1,500 GPM, 350 ft. head, 1,150 RPM.

Low initial cost, quick starting, powerful Sterling engines for direct connections have been specially developed for standby service. Sterling has the engineering talent and always enjoys working out installations requiring special features—automatic starting if you wish.

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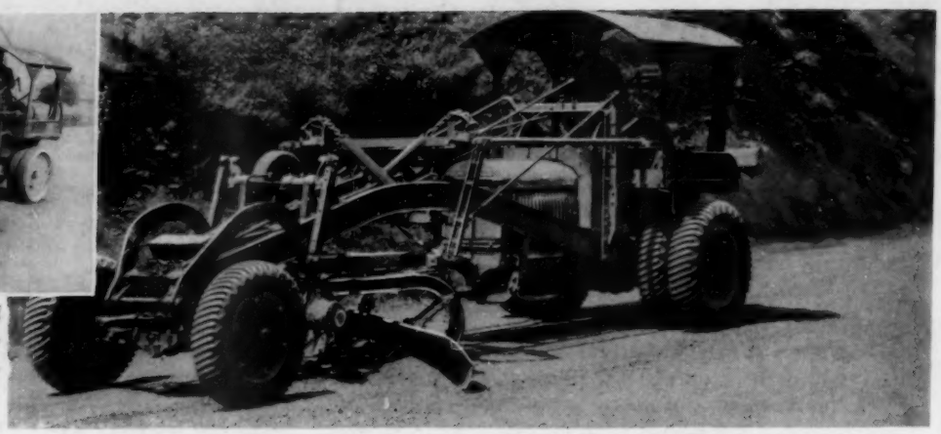
BUFFALO, N. Y.

DEPT. C-5

Branch Office
900 CHRYSLER BLDG.,
NEW YORK, N. Y.

See page 51 for reviews of latest INDUSTRIAL LITERATURE

Before change-over. Grader on old solid rubber tires. See the transformation in the other photograph.



20-ton power grader of Highway Department, Snohomish County, Washington, brought up to date with Goodyear Pneumatic Lug Tractor Tires.

Cut costs! *Change over to*

GOODYEAR PNEUMATIC LUG TRACTOR TIRES

PUT road jobs on a paying basis! Obsolete graders and tractors now on solid rubber or steel come to life again when changed to Goodyear Pneumatic Lug Tractor Tires.

More power and speed . . . more even pull . . . more miles per day on road or field . . . more kinds of work . . . longer life; fewer repairs; radiator and motor better protected . . . less delay in changing jobs; fuel saving up to 20 per cent; less slippage means long tire mileage.

Look at the special tread design! Here's a tire that holds to any type of road surface or the softest ground without "side-slip." And it's the only non-skid tire for road work that is SELF-CLEANING. The carcass is built of the patented, extra-elastic Goodyear Supertwist Cord that stands up under heaviest service.

See your tractor and grader dealer about change-overs to Goodyear Pneumatic Lug Tractor Tires. He can prove greater efficiency and money saving. Or write or call the Goodyear Government Sales Department, Akron, Ohio, or Los Angeles, Calif., for full information as to the right types and sizes for your operations. *Act now!*

THE GREATEST NAME IN RUBBER

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SPECIFY GOODYEAR PNEUMATIC LUG TRACTOR TIRES ON NEW GRADERS AND MAINTAINERS